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EARTHQUAKES IN THE USSR IN 1973

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EARTHQUAKES IN THE USSR IN 1973

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CONTENTS PAGE

CONTENTS (Continued) Page

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[Text] This collection, "Earthquakes in the USSR in 1973," is devoted to articles with a description of the instrument and macroseismic data on the earthquakes of various seismoactive zones (the Carpathians, the Crimea, the Caucasus, Kopet Dat, Central Asia, Northern Tian Shan, Altay-Sayan, Baykal, Yakutiya, the Northeastern USSR, the Arctic, Sakhalin, Kuril Islands and Kamchatka), located on the territory of the USSR and adjacent (boundary) regions. All the articles contain catalogs of earthquakes and maps of the epicenters. The collection contains articles with a brief survey of the seismicity of the territory of the USSR with respect to earthquakes with $M \geqslant 4.5$ and of the world--with $M \geqslant 6$.

Separate articles give a description of the individual, most noteworthy events of this year, such as the strong earthquake on 28 February, accompanied by a large number of repeated jolts, and the June series of strong earthquakes in the area of the Kuril Islands.

The collection is designed for a broad range of seismologists, including specialists in earthquakeproof contruction and seismological engineering, and will undoubtedly be of interest to geophysicists and geologists engaged in the study of tectonic processes in seismoactive regions.

INTRODUCTION

A large part of the territory of the USSR, particularly its southern and eastern regions, is subject to earthquakes. Over 200 permanent seismological stations register these earthquakes in order to obtain observation meterial for the study of seismic danger in individual regions, the plutonic structure of the earth and forerunners of strong earthquakes.

This material from the observations, after primary processing and summarization for individual large regions, is published yearly in the form of the articles in this collection. The articles contain a brief analysis of the seismicity during the year and are accompanied by a catalog of earthquakes, a map of the epicenters and macroseismic information.

The catalogs of earthquakes, compiled in the form of an Atlas of Earthquakes in the USSR, contain: the time when the earthquake occurred (Greenwich mean time), the coordinates of the epicenter (in tenths and hundredths of a degree), the depth of the focus (without parentheses--according to instrument data, and in parentheses--according to macroseismic data), the class of accuracy (A--the error does not exceed 25 kilometers, B--50 kilometers, a--5 kilometers, b--10 kilometers, and if a column is not filled in--the error may be over 50 kilometers), the magnitude M_L and m_{PV} and the energy class (K), which are determined in accordance with the Instructions on the Procedure for Performing and Processing Observations at Seismological Stations of the Unified System of Seismic Observations of the USSR, 1966. For relatively strong earthquakes, numbers are given in the catalog in accordance with which they are easy to find on the map of epicenters.

Seismic Regions of the USSR

Region	Regional Boundaries		Institutes responsible for compiling articles
	φ °N	λ °E	
Carpathians	45–50	22–31	L'vov Branch of Mathematical Physics of the Institute of Mathematics of UkSSR Academy of Sciences
Crimea	43–45	32–37	Department of Seismology of UkSSR Academy of Sciences
Caucasus	38–45	37–52	Institute of Geophysics of Georgian SSR Academy of Sciences (responsible), Institute of Geology imeni I. M. Gubkin of Azerbaijan SSR Academy of Sciences
Kopet Dag	36–44	52–65	Institute of Physics of the Earth and Atmosphere of Turkmen SSR Academy of Sciences
Central Asia	36–46	65–81	Institute of Seismology of Uzbek SSR Academy of Sciences (responsible), Institute of Earthquakeproof Construction and Seismology of Tadzhik SSR Academy of Sciences, Institute of Geology of Kirgiz SSR Academy of Sciences, Institute of Geological Sciences of Kazakh SSR
Altay and Sayan	45–46	80–100	Institute of Geology and Geophysics of Siberian Branch of USSR Academy of Sciences
Baykal	48–60	100–120	Institute of the Earth's Crust of the Siberian Branch of USSR Academy of Sciences
Yakutiya	54–72	120–148	Yakutsk Branch of the Siberian Branch of USSR Academy of Sciences
North-East	58–66	144–158	Northeastern Complex Scientific Research Institute of the Far Eastern Scientific Center of USSR Academy of Sciences
Far East	43–52	130–157	Sakhalin Complex Scientific Research Institute of Far Eastern Scientific Center of USSR Academy of Sciences
Kamchatka and Komandorskiy Islands	50–60	156–168	Institute of Volcanology of Far Eastern Scientific Center of USSR Academy of Sciences
Arctic	60–90	38–169W	Central Seismological Station, Pulkovo, of Institute of Physics of the Earth of USSR Academy of Sciences

For the Carpathians, the Caucasus, Northern Tian Shan, Altay, Yakutsk and Sakhalin the numbers are given for earthquakes with $K \geqslant 11$, for Central Asia, Baykal and Kamchatka--with $K \geqslant 12$, and for the Kuril Islands--with $M \geqslant 5.5$. In addition, the catalog gives numbers of the regions in accordance with the system of dividing zones into smaller regions with respect to the seismotectonic features, and macroseismic data are presented that have been obtained in small volume and are not included in the text of the article.

For regions with a relatively low level of seismicity or a small number of seismological stations, all the recorded earthquakes are placed in the catalog for which the epicenters were determined (Carpathians, Crimea, Kopet Dag and Northern Tian Shan), for Yakutsk and Sakhalin with $K \geqslant 8$, for the Far East, with $K \geqslant 10$ and for the remaining regions, with $K \geqslant 9$.

The data on the mechanism of the focus are assembled in a table, which indicates the directions and angles of incidence of the possible fault planes (A_z, α), the relative values of the shift component in the direction of the strike and dip of the fault planes (a plus sign designates upthrusts or overthrusts and righthand shifts, and a minus sign--faults or pushes and lefthand shifts) and the parameters of orientation of the stress axes: A_z is the stress axis azimuth, reckoned from the direction to the north to the horizontal projection (upper) end of the axis, and e --the angle formed by the stress axis with the horizon.

The articles describing the earthquakes were prepared by republic and peripheral institutes. The table gives a list of the principal seismoactive zones, indicates their boundaries and the names of the institutes responsible for writing the articles.

At the Institute of the Physics of the Earth the data on the strong earthquakes on USSR territory (with $M \geqslant 4.5$) and in the world (with $M \geqslant 6$) are summarized. Z. I. Davydenko has done a great deal of work on the technical drawing up of the collection for press.

STRONG EARTHQUAKES ON USSR TERRITORY

I. V. Gorbunova

A survey of the seismicity of USSR territory has been made yearly for earthquakes with $M \geqslant 4.5$, the parameters of which were taken from the Seismological Bulletin of the network of seismological stations in the USSR. Analysis of the data published for 12 years (see table) indicates that earthquakes with M=4.5 for individual seismoactive zones are processed not entirely in accordance with the data of the support network of stations, which can be clearly seen from the graphs of the frequency (Fig. 1) from the deviation of the points corresponding to the number of earthquakes of this level of magnitude from the straight-line graph. The linear nature of the graphs and their slopes (γ =0.80) are well confirmed by the number of earthquakes with high magnitudes.

Earthquakes with M=4.5 omitted by the processing, according to the data from the Support Network for Central Asia, constitute approximately 40 percent, and for the seismoactive zones of Baykal, the Carpathians and Yakutiya --80 percent. For the regions of the Caucasus, Kopet Dag and Altay-Sayan all earthquakes with M=4.5 are recorded, and are not omitted in the processing. For the Far East only earthquakes with $M \geqslant 5$, the epicenters of which lie in the sea, are processed. A small number of earthquakes with M=4.5 correspond to the coastal, seismically less active area of the Far East.

The omission of a certain number of earthquakes in individual seismoactive regions with M=4.5 may be explained, on the one hand, by the relatively low accuracy of determining the magnitude and mainly by not accounting for the error in its determination, and on the other hand--by the remoteness of the main support stations from the epicentral zones of the belt near the boundary. The parameters of the earthquakes omitted and the energy class in this case are determined from the data of the regional stations. Therefore, since 1972 the Catalog of Strong Earthquakes has been compiled in consideration of all the earthquakes with K=12, which, according to the average correlational relationship [1, 2], correspond to M=4.5. The data on the parameters of these earthquakes are taken from the regional catalogs.

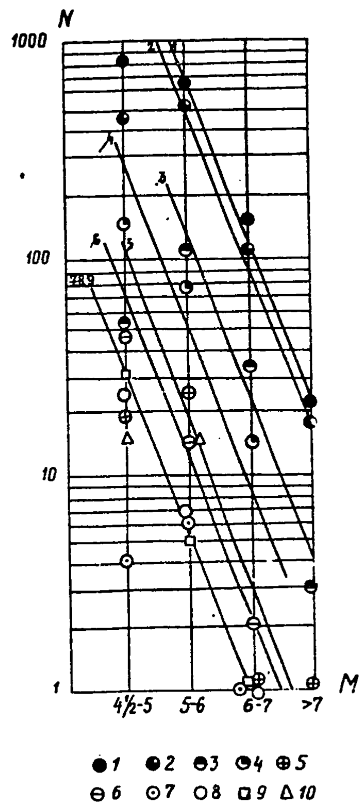

Figure 1. Graphs of the Frequency of Earthquakes

1--USSR territory; 2--Far East (shallow earthquakes); 3--Far East (deep earthquakes); 4--Central Asia (shallow earthquakes); 5--Baykal; 6--Caucasus; 7--Yakutiya; 8--Altay-Sayan; 9--Kopet Dag; 10--Carpathians

In compiling the seismological bulletin, just as before, the epicenters were determined on an electronic computer in accordance with the EPI program, using nearby and distant stations surrounding the epicenter. The catalog for strong earthquakes with $M \geqslant 5.5$ gives numbers from which they may easily be found on the map of epicenters (Fig. 2). A description of the methods for determining individual epicenters with K=12, for which the magnitude was not determined, is given in the articles devoted to describing the seismicity of a region.

In 1973 there were 179 earthquakes with $M \geqslant 4.5$ on USSR territory. This number included earthquakes in Hindukush and the Kuril-Kamchatka arc only with $M \geqslant 5$. Their distribution by magnitudes and seismoactive zones is shown in the table. As in the preceding collections, the amount of conditional deformation was calculated in units of 10^{10} $ergs^{1/2}$, the values of which for the seismoactive zones are given below.

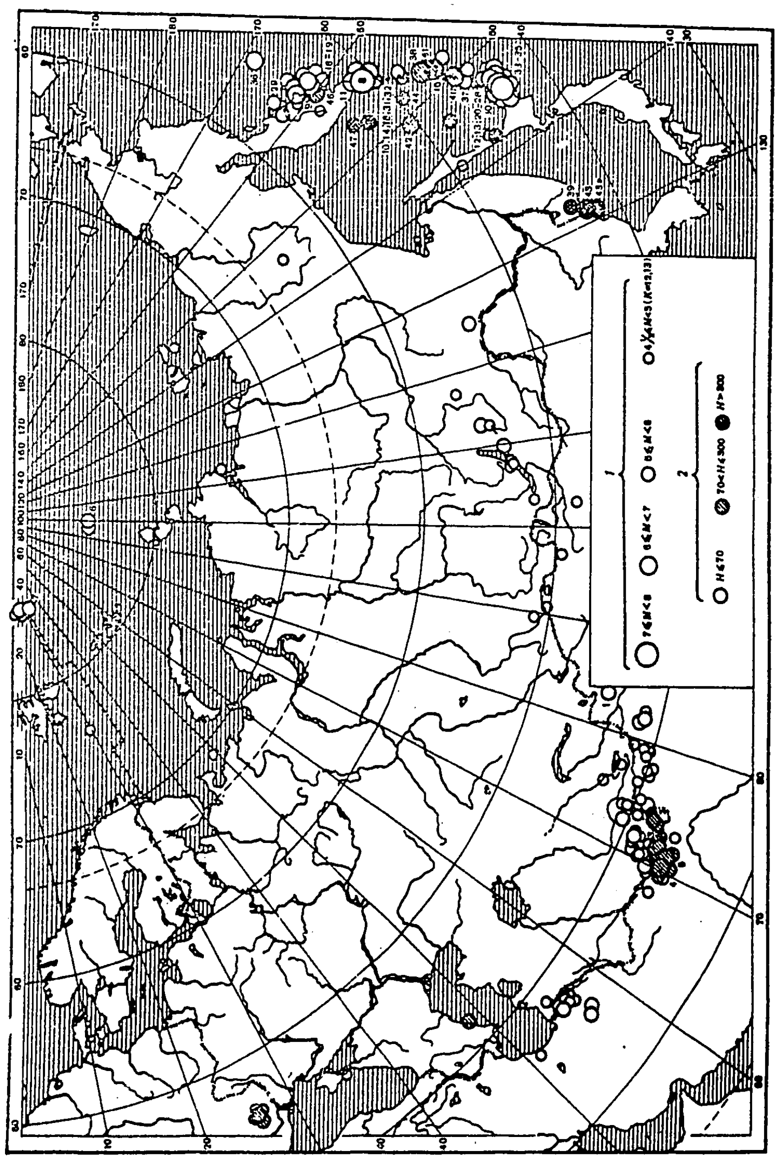

Figure 2. Map of Epicenters of Earthquakes on USSR Territory With $M \geq 4.5$

1--magnitude; 2--focal depth, in km. Figures on map--numbers of earthquakes with $M \geq 5.5$ (according to catalog)

Distribution of Earthquakes by Magnitude and Regions

(1) № зоны	(2) Зона	$4{,}5 \leqslant M < 5$		$5 \leqslant M < 6$		$6 \leqslant M < 7$		$M \geqslant 7$	
		1962–1972 гг.	1973 г.	1962–1972 гг.	1973 г.	1962–1972 гг.	1973 г.	1962–1972 гг.	1973 г.
(3) I	Крым	1	(1)	–	–	–	–	–	–
(4) II	Карпаты	16	1(2)	15	2	–	–	–	–
(5) III	Кавказ	45		14	1	2	–	–	–
(6) IV	Копетдаг	32	6(6)	5	3	1	–	–	–
(7) V	Средняя Азия:								
(8)	в земной коре	159	7(22)	76	7	14	–	–	–
(9)	под корой	66	2(3)	119	16	16	2	2	–
(10) VI	Алтай и Саяны	26	2	7	–	–	–	1	–
(11) VII	Байкал	19	1(9)	15	1	1	–	1	–
(12) VIII	Якутия	4	(1)	6	1	1	–	1	–
(13) IX	Дальний Восток:								
(8)	в земной корс	493	6	511	39	112	15	17	3
(9)	под корой	53	1	104	7	34	7	3	–
(14) X	Арктика	14	3(2)	10	4	–	–	1	–
(15)	Вся территория СССР:								
(8)	в земной коре	809	26(43)	659	58	147	15	21	3
(9)	под корой	119	4(3)	223	23	50	9	5	–

(10) Примечание. В скобках – число землетрясений с K = 12–13, для которых магнитуда не определена.

Key:

1. Number of zone
2. Zone
3. Crimea
4. Carpathians
5. Caucasus
6. Kopet Dag
7. Central Asia:
8. In earth's crust
9. Beneath crust
10. Altay and Sayan
11. Baykal
12. Yakutiya
13. Far East:
14. Arctic
15. Entire USSR territory
16. Note. In the parentheses are the number of earthquakes with K= 12-13, for which the magnitude was not determined.

The amount of conditional deformation, $\Sigma\varepsilon^{1/2}\cdot 10^{10}$erg: I--0.15; II--0.75; III--0.2; IV--3.21; V--9.34, deap--5.82; VI--2.0; VII--2.70; VIII--1.2; IX--244.68, deep--16; X--4.41. Figure 3 shows its change in time during the last 12 years for the 4 most seismically active zones.

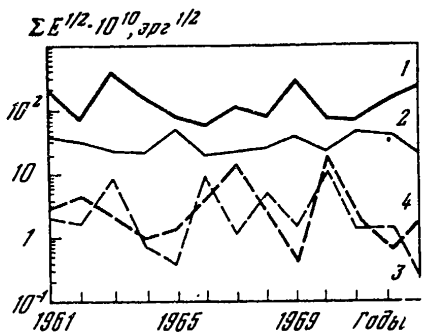

Figure 3. Change in the Value of $\Sigma\varepsilon^{1/2}$ in Time in 1961-1973 for the Principal Seismoactive Zones

1--Caucasus; 2--Baykal; 3--Central Asia; 4--Far East

An analysis of the map of the epicenters, tables and graphs makes it possible to draw the conclusion that the Far East, just as in the preceding years, was the most active. The Kuril Island region is characterized by the greatest seismic activity. Strong earthquakes with $M > 5$ occurred along the entire Kuril ridge, and a total of 47 of them was registered. Most seismically active, however, were the northern and southern parts of the Kuril ridge. North of the Kuril Islands, east of the islands of Parmushir and Shumushu, a number of strong earthquakes occurred, of which the one on 28 February at 06:37 had M=7.5 (No 8.). The earthquake caused a strong macroseismic effect and was accompanied by repeated jolts, of which 50 were perceptible, with the effect of the shock at the surface being 6 points.

The greatest tremors from the main jolts, reaching 8 points, were observed in the coastal area of the Lesser Kuril ridge and the islands of Shumushu and Paramushir. A separate article in this collection is devoted to a description of the aftereffects of this earthquake.

South of the Kuril Islands, in the region of the islands of Kunashir and Iturup, three extremely strong earthquakes were recorded: on 17 June at 03:55 with M=7.9 (No 20), on 24 June at 02:43, with M= 7.6 (No 22), and on 26 June at 22:31 with M=6.9 (No 27). All three jolts were accompanied by a very strong macroseismic effect, which was manifested on the nearby islands with an intensity of 7-8 points. A tsunami was observed from the first two. These earthquakes were studied in detail, and a separate article is also devoted to them.

The epicenters of the deep earthquakes in the Sea of Okhotsk were located in quite a narrow belt extending from the south of Sakhalin Island to the western coastal area of Kamchatka. The strongest one was recorded on 28 July in its central region at a depth of 597 kilometers, with a magnitude of m_{PV} = 6.1 (No 42). Two deep earthquakes (Nos 43 and 39) were observed in the coastal section of the west of the Sea of Japan. The seismicity of Kamchatka continued to remain on the average at the level of 1961-1972. In some regions of it, however, an increase in activity was noted: in the region of the Kronotskiy Peninsula and Kronotskiy Bay on 4 March there was an earthquake with M=6.2 (No 9) and on 27 November with M=6.0 (No 46).

At Sakhalin the strongest was an earthquake with M=4.7 on 4 November, at 13:01 in Sakhalin Bay, where, according to instrument statistics, no earthquakes had been observed in the last 60 years. The earthquake was felt at a number of population centers in northern Sakhalin and Khabarovskiy Kray with an intensity of 3-4 points.

On 6 February at 20:47 there was an earthquake in northwestern Uglegorsk with M=4.5, which was felt in Uglegorsk with an intensity of 6-7 points and was accompanied by a series of aftershocks.

Central Asia is in second place after the Far East with respect to the level of seismic activity.

The highest seismicity, caused by shallow earthquakes, was observed, as before, in Pamir. In 1973, however, it was lower than in 1972, and the seismic energy was released by approximately one order of magnitude less.

The strongest earthquakes, with a magnitude of M=5.2, were on 3 February at 14:31, with the epicenter on the southwestern slopes of the Alayskiy Range, and on 2 April at 02:43, on the border of the USSR and Afghanistan. The latter was felt with an intensity of 6 points in at area of about 400 square kilometers. An earthquake of similar intensity was registered in South Pamir on 12 October at 02:54, which was felt in the villages of Mun and Debast (25 kilometers northeast of Khorog) with an intensity of 7 points. The earthquake caused slides and considerable damage to structures in these villages. In the Northern Tian Shan region the seismicity was lower in level than in the preceding years. All the principal earthquakes were confined to the boundary of Southern Tian Shan and Northern Pamir. For example, a large group of earthquakes was observed in the Garm region, six of which were with K=12 ($M \sim 4.5$), in the southern spurs of the Kokshaal-Tau Range, among which four were in the 12th energy class. Central Tian Shan was somewhat activated in comparison with the preceding year: here two earthquakes were recorded on 6 February at 20:37, with K=12, and on 18 February at 21:39, with M=4.7. Both were felt over a wide area.

Two earthquakes with K=12 were also registered in Northern Tian Shan. Their epicenters were located in the central part of Terskey-Alatau (on 14 April at 19:49), and in the northeastern part of the Kirgiz Range (on 1 September at 12:32, with M=4.6).

In the Pamir Hindukush zone, extended along the northern spurs of Hindukush, the strongest earthquake occurred on 17 October at 03:16, with $m_{PV} = 6$.

The Altay-Sayan zone is considerably lower in 1973 with respect to the level of its seismic activity than in the three preceding years. During the year two earthquakes with M=4.5 were recorded; the epicenter of one of them--on 30 April at 07:29--was located at the juncture of Western Sayan and the Shapshal'skiy Range, in a zone of relative seismic quiescence for the preceding years. The earthquake was accompanied by a brief series of aftershocks.

The second earthquake occurred on the spurs of the Tannu-Ola Range on 18 August at 10:18, the epicenter of which falls into the aftershock zone of the earthquake on 15 May 1970.

There were nine earthquakes with K=12 and two with $M \geqslant 5$ in the Baykal region in 1973. Almost all of them were located in a narrow belt stretching from the southwest end of Lake Baykal to the northeast, through its central section into the Stanovoy uplands. The epicenters of the strongest earthquakes were located in the central part of Baykal (on 14 October at 00:58, with M=5) and further to the northeast in the Stanovoy uplands (on 16 June at 12:12, M=5.1). This belt may be extended to the southwest through Lake Khubsugul to Mongolian territory.

The earthquakes on 25 January at 19:00 and on 14 October at 00:58, the epicenters of which were closer to population centers, were felt. For example, the first one was felt with an intensity of 5 points at the port of Baykal and other population centers located from 30 to 100 kilometers from the epicenter; the second was felt with an intensity of 5-6 points 18 kilometers from the epicenter in the settlement of Dushelan, and with an intensity of 3-4 points approximately 55 kilometers away.

In Yakutiya, just as in the preceding years, the southern regions were the most seismically active. The region south of the Stanovoy Range was distinguished by greater activity, and it was there on 2 November in the area of the Tukuringra Range that a strong earthquake occurred with M=5.4, accompanied by aftershocks, that was felt with an intensity of 7 points 25 kilometers away. The system of Cherskiy ranges in the northeast of the territory is noticeably singled out for the seismic activity; an earthquake with K=12 was among the strongest here.

We will discuss the analysis of the seismicity of the zones located west of Central Asia. The first of them is Kopet Dag. The earthquake on 20 August at 01:27 in the western section was the strongest on the territory of Turkmeniya. Its focus was confined to the southwestern spurs of the

Karatag Range. Five earthquakes with K=13 occurred on the territory of the central part of Northern Iran, where, just as before, there was increased seismic activity as compared with Kopet Dag proper.

In 1973 the Caucasus was less active seismically. The strongest earthquake was one with m_{PV} = 5.4 at a depth of 75 kilometers under the Caspian Sea. The seismicity was manifested mainly by earthquakes with $M < 4.5$

In the Crimea there was one earthquake with K=12 in February at 11:38 in the region of the city of Feodosiya.

In the Carpathians the strongest earthquakes were observed on Romanian territory, in the Vrancha region, five of which were felt in Kishinev with an intensity of 2-3 points. The strongest was the earthquake on 20 August at 15:18, with M=5.2.

In the Arctic the greatest activity was noted in the region of the Otto Schmidt Range, where there were five earthquakes with $M \sim 4.7$-5.5. The renewal of seismic activity in this region began with the earthquake in 1971 on 15 December at 23:00, with $M \sim 5$, registered south of Novaya Sibir' Island (Novosibirskiye Island archipelago), where no earthquakes had been recorded previously.

Catalog of Earthquakes in USSR With $M \geqslant 4.5$ During 1973

Key:

1. Number, in order
2. Month
3. Date
4. Time of origin, hrs, mins, secs
5. Coordinates of epicenter, φ°N
6. Coordinates of epicenter, λ°E
7. Focal depth, in km
8. M^*_L
9. m^*_{PV}
10. K
11. Region

№ п/п	Месяц	Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	M^*_L	m^*_{PV}	K	Район
				φ°N	λ°E					
1	2	3	4	5	6	7	8	9	10	11
				Carpathia						
	I	5	12 37 48	45,5	26,5	130			12	Горы Вранча
	VIII	20	15 18 29	45,7	26,4	80		5,2**		" "
	IX	7	19 37 52	45,8	26,5	137		4,9**		" "
	X	23	10 50 59	45,6	26,5	175		5,0**		" "
	XII	21	02 46 35	45,5	26,5	150			12	" "

1	2	3	4	5	6	7	8	9	10	11
					Crimea					
	II	20	11 38 53	44,90	36,35				12	Восточнее Феодосии
					Caucasus					
	XII	14	09 11 46	41,9	49,0	175		5,4**		Каспийское море
					Kopet Dag					
	I	19	05 49 36	36,6	57,2	42			12	Горы Эльбурс
		29	13 24 55	37,1	55,8	40			13	" "
	V	17	16 11 35	35,7	57,6	38			13	" "
		22	00 50 12	35,3	57,1	45			13	" "
	VIII	2	19 56 26	37,4	56,6	30	4,9	5,9; 5,3**		" "
			20 28 55	37,3	56,6	30	4,6	5,1**		" "
		4	18 12 05	37,3	56,5	35			12	" "
		20	01 27 56	38,7	55,1				12	Копетдаг
	IX	17	04 06 03	36,5	51,1	38	4,8	5,0**		Горы Эльбурс
					Central Asia Earthquakes with focuses in earth's crust					
	I	3	14 31 01	39,2	71,8	10	5,2	5,6**		Северный Памир
			15 05 14	39,1	71,8				12	" "
		9	16 17 50	39,5	73,9				12	Западный Куньлунь
		29	04 32 08	36,3	73,3				12	Гиндукуш
		31	22 49 02	37,1	69,5				12	"
	II	5	00 19 59	38,8	70,1				12	Северный Памир
		6	13 24 02	39,8	77,2				12	Пустыня Такла-Макан
			20 37 43	41,0	74,1				12	Центральный Тянь-Шань
		8	01 08 51	37,3	69,2				12	Северный Памир
			02 28 01	36,6	68,3				12	Гиндукуш
		18	21 39 01	40,7	74,2	30	4,7	5,1**		Центральный Тянь-Шань
	III	3	10 22 48	40,2	79,0	52	~4,5			Пустыня Такла-Макан
	IV	1	09 45 22	40,5	72,8	33		5,2**		Ферганская долина
1		2	02 43 25	37,7	69,7	53	5,2	5,1**		Северный Памир
		14	19 49 44	42,0	77,4	15			12	Северный Тянь-Шань
		21	04 29 20	38,9	70,4	5			12	Северный Памир
	V	8	11 04 00	39,4	71,0	10			12	Южный Тянь-Шань
		15	04 17 06	39,9	77,8	52	4,2			То же
		17	09 38 10	41,1	82,2	35	5,2	5,3**		"
			11 06 57	40,1	79,1				12	"
	VI	1	12 46 08	41,2	82,1	29	4,9	5,2; 4,9**		Пустыня Такла-Макан
1		2	23 57 04	44,2	83,5	27	5,7	6,2; 6,0**		хр. Боро-Хоро

1	2	3	4	5	6	7	8	9	10	11
				Deep Pamir-Hindukush Earthquakes						
	I	12	23 39 25	36,1	70,6	120		5,4**		Гиндукуш
	II	14	12 28 35	36,5	70,7	170			13	"
	III	17	12 19 07	38,5	74,1	130		4,5**		Южный Памир
2		26	07 58 42	38,4	73,9	116		5,8; 5,6**		" "
			08 33 31	38,4	73,9	120		5,1; 5,2**		" "
	IV	6	16 57 31,1	38,2	74,1	150		4,9**		" "
		10	18 07 49	36,7	71,3	120		5,0**		Гиндукуш
		12	08 31 06	36,4	70,9	180		5,0**		"
3		25	03 16 50,5	37,7	72,2	115		5,8; 5,3**		Южный Памир
	V	6	13 22 47	36,5	70,3	220			13	Гиндукуш
		15	18 40 32	37,3	71,6	131		5,0**		Южный Памир
	VI	6	15 51 16	36,4	70,7	213		5,1**		Гиндукуш
		14	18 20 28	36,4	70,9	200		5,1**		"
4	VIII	6	01 17 55	36,5	70,1	224		5,8; 5,6**		"
		15	15 09 09	36,5	70,9	200		5,0**		"
		22	03 43 48	36,5	71,3	231		~5,0**		"
	IX	22	11 36 00	36,1	70,4	97		5,2**		"
		25	13 00 18	36,5	70,9	210		5,1**		
		25	18 39 00	36,8	71,3	90			13	"
5	X	17	03 16 18	36,4	71,1	220		6,0; 5,6**		" "
	XI	2	22 20 59	36,2	69,6	135		~5,0**		"
		16	03 37 01	37,4	72,1	200		5,0**		Южный Памир
	XII	12	22 40 50	36,3	71,1	150		~5,0**		Гиндукуш
				Altay						
	IV	30	07 29 49	51,0	89,7	30	~4,5	5,0**		Западный Саян
	VIII	18	10 18 42	50,2	91,0	52	4,5	5,1**		Отроги хребта Танну-Ола
				Baykal						
	I	25	19 56 48,6	51,68	103,93				12	Юго-западное окончание Байкала
	II	26	05 40 12,3	56,56	117,75				12	Становое нагорье
		28	10 17 22,1	53,00	107,83				12	оз. Байкал
	IV	12	08 30 09,5	48,40	102,93				12	Северная Монголия
	V	10	13 46 30,1	54,85	112,56				12	Становое нагорье
		22	10 13 37,1	53,23	108,07		~4,0		12	Центральный Байкал
	VI	16	12 12 26	55,0	112,6	10	5,1	4,8**		Становое нагорье
	VIII	1	13 11 35,5	49,45	97,30				12	Монголия
	IX	18	13 56 30,3	53,14	107,75				12	оз. Байкал
	X	14	00 58 21	53,6	109,8	27	5,0	4,8**		Восточнее оз. Байкал
	XII	16	14 43 58,5	50,64	98,07				12	Граница СССР и Монголии

1	2	3	4	5	6	7	8	9	10	11
				Yakutiya						
	VI	8	11 43 51	64,0	146,3					хр. Черского
	XI	2	07 31 34	54,0	125,6	30	5,4	5,7; 5,3**		хр. Тукурингра
				Arctic						
	I	23	21 39 36	75,0	114,0				12	Море Лаптевых
	IX	24	09 08 39	86,2	33,2	30	4,7	5,7		р-н о-вов Земля Франца-Иосифа
	X	14	22 07 46	85,0	99,7	30	5,2	5,8; 5,4**		хр. Отто Шмидта
6		18	11 40 22	85,1	98,6	30	5,5	5,2**		То же
	XI	5	11 58 18	76,0	30,0				12	Юго-восточнее Шпицбергена
7		9	13 42 43	86,0	34,и	30	5,5	5,5**		хр. Отто Шмидта
			14 47 36	86,1	31,6	20	4,9	5,4**		То же
			15 09 33	86,1	30,9	13	5,0	5,4**		"
	XII	15	23 31 44	74,3	147,2	30	4,7	5,2**		Новосибирские острова
				Far East						
				Earthquakes with focuses in earth's crust						
	I	25	18 32 30	54,5	161,7	40	5,0	5,0**		Восточнее Камчатки
	II	6	20 46 50	49,2	141,9	10–20	4,5			о-в Сахалин
		10	16 55 38	49,8	156,3	70	5,3	5,6*		Восточнее Курильских островов
8		28	06 37 54	50,4	156,7	70	7,5	7,2; 6,5**		То же
			11 32 44	50,1	157,0	60	5,2	5,1**		"
	III	1	02 19 06	50,0	157,1	45	5,1	5,3**		"
9		4	17 57 46	54,8	161,7	58	6,2	6,2; 6,1**		Камчатка
10		12	11 14 25	50,1	156,7	55	5,6	6,2; 5,7**		Восточнее Курильских островов
11			19 39 21	50,8	157,2	71	6,3	6,5; 6,1**		То же
		25	08 56 16	50,1	157,1	40	5,2	5,2; 5,3**		"
	IV	4	21 50 55	43,3	147,8	35	5,1	5,1**		"
			23 56 44	43,3	147,9	35	5,1	5,4**		"
12		5	22 17 01	43,5	147,8	47	6,0	6,1; 5,7**		"
			23 33 58	43,3	148,0	30		5,3**		"
		6	00 01 57	43,4	147,8	30	5,3	5,6**		"
13			01 48 00	43,4	147,8	25	5,8	6,3; 5,8**		"
14		12	13 49 15	50,7	157,6	70	6,3	6,4; 6,2**		"
15		17	22 09 51	50,8	157,6	60	5,7	5,8; 5,7**		"
		29	21 36 16	56,8	161,9	5	~5,0	5,0**		Камчатка

1	2	3	4	5	6	7	8	9	10	11
	V	18	10 36 52	44,5	149,4	55		5,3	6,3; 5,7**	Восточнее Курильских островов
	VI	9	01 37 25	53,7	160,6	40		5,0	5,2**	Восточнее Камчатки
			22 46 01	53,0	160,2	40		5,0	5,4**	То же
16		11	08 42 04	53,5	161,7	45		6,5	6,4; 5,9	"
17		12	14 21 23	53,5	161,7	10–20		5,8	6,2; 5,5**	"
18		15	11 20 46	53,4	161,4	54		6,2	6,4; 6,1**	"
			13 16 53	53,5	162,0	20		5,1	5,0**	"
19			21 09 38	53,5	161,6	10		5,7	6,0; 5,6**	"
20		17	03 55 02	43,2	145,8	50		7,9	7,4; 6,9**	Восточнее Курильских островов
			08 48 20	43,0	146,5	45		5,1	5,2**	То же
		19	02 22 06	43,0	146,7	35		5,3	6,0; 5,4**	"
			08 36 18	43,0	146,4	50		5,0	5,2**	"
21		22	06 07 37	43,0	146,5	51		6,4	6,4; 5,8**	"
		23	02 09 41	43,1	147,3	50		5,3	6,1; 5,6**	"
22		24	02 43 25	43,4	146,5	57		7,6	7,5; 6,8**	"
23			03 04 16	43,1	146,9	42			6,2**	"
24			03 28 36	43,2	146,8	20			5,9**	"
			03 47 48	43,0	146,5	30			5,4**	"
25			05 07 47	43,2	146,7	53		6,0	6,2; 5,7**	"
			20 00 15	43,2	146,8	30		5,2	5,5**	"
		26	11 39 24	43,0	146,8	25		5,1	5,2**	"
26			18 02 25	43,2	147,1	50		6,2	6,2; 5,8**	"
27			22 31 59	43,2	146,7	50		6,9	6,7; 6,4**	"
		27	01 41 16	43,0	146,6	50		5,0	5,5*	"
28		29	03 26 53	43,3	145,8	55		5,5	6,5; 5,8**	Курильские острова
	VII	2	05 56 13	54,1	163,9	40		5,0	5,8; 5,7**	Восточнее Камчатки
		5	00 58 44	43,8	148,1	30		5,2	6,0; 5,4**	Восточнее Курильских островов
		9	02 04 10	54,4	158,4	0–5		4,5	5,2**	Камчатка
		15	14 06 51	43,4	146,6	40		4,7	5,3**	Восточнее Курильских островов
		29	14 51 02	43,0	146,8	30		5,2	6,1; 5,6**	То же
29	VIII	3	17 23 52	54,6	162,6	0		5,9	5,4**	Восточнее Камчатки
			19 13 04	43,0	147,8	40		5,0	5,0**	Восточнее Курильских островов

1	2	3	4	5	6	7	8	9 10	11
30		9	10 44 26	43,5	146,5	57	5,8	6,8; 6,1**	Восточнее Курильских островов
		25	12 15 50	56,1	163,7	5–10	5,1	5,6; 5,5**	Восточнее Камчатки
	X	3	10 35 51	45,4	152,0	30	5,4	5,4**	Восточнее Курильских островов
		24	04 43 26	56,2	163,0	20	4,6	5,0**	Камчатка
	XI	4	13 01 42	53,9	141,9	20–30	4,7	5,2**	Сахалинский залив
31		8	08 59 11	49,9	156,4	55	6,3	6,5; 5,9**	Восточнее Курильских островов
32		11	02 43 07	49,9	156,5	65	6,0	6,4; 6,1**	То же
		17	00 26 27	43,0	147,5	30	5,0	5,0*	"
		20	16 57 34	52,4	160,8	0–10	5,4	5,5**	Восточнее Камчатки
33	XII	1	10 38 53	43,1	146,1	40	5,5	6,1; 6,5**	Восточнее Курильских островов
34			23 16 56	43,1	147,1	30	6,2	5,9; 5,3**	То же
35			23 18 06	43,3	146,7	55	6,5	6,4; 6,4**	"
		17	21 54 07	48,4	154,1	50	5,3	5,5*	Восточнее Курильских островов
36		29	08 20 12	54,6	168,6	15	6,3	6,0; 5,7**	Восточнее Командорских островов

Deep Earthquakes

1	2	3	4	5	6	7	8	9 10	11
	I	15	01 53 13	45,9	142,4	345		5,2**	Южнее о-ва Сахалин
37	II	17	19 15 14	45,0	148,8	130		5,5**	Восточнее Курильских островов
	III	21	21 46 13	48,7	153,7	105–110		5,1**	То же
38	IV	8	21 54 59	47,1	152,2	110		6,3; 5,7**	"
		9	11 52 19	52,3	152,6	470		~5,0**	Охотское море
39	V	6	14 39 28	43,5	132,4	499		5,9; 5,7**	хр. Сихотэ-Алинь
40		8	07 49 00	45,6	149,8	107		6,0; 5,6**	Восточнее Курильских островов
41	VI	13	00 20 52	46,6	151,5	175		6,1; 5,6**	Курильские острова
	VII	16	20 45 27	55,0	161,1	90		4,7**	п-ов Камчатка
42		28	20 06 35	50,3	149,0	597		6,1; 6,1**	Охотское море
43	IX	10	07 43 33	42,4	131,1	573		6,5; 6,3**	Японское море

1	2	3	4	5	6	7	8	9	10	11
43a		29	00 44 02	42,0	131,0	600		7,2; 7,6**		Японское море
	X	24	11 28 35	48,0	146,6	500		5,2**		Охотское море
44	XI	13	02 47 16	49,6	151,5	325		5,7**		" "
45		21	21 05 23	46,1	151,6	90		6,2; 5,5**		Восточнее Курильских островов
46		27	13 52 30	53,6	160,4	78		6,0; 6,0**		Восточнее Камчатки
47		29	17 59 20	53,2	153,5	490-500		5,6**		Охотское море

* Magnitudes M_L and m_{PV} were determined from type SK and SKD average-period instruments.

** Same, from short-period SKM-3 instruments.

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EARTHQUAKES IN THE CARPATHIANS

O. P. Kostyuk, I. M. Rudenskaya, T. S. Karpiv

In 1973, during the processing of Carpathian earthquakes, materials were used from the observations of seismological stations in the Carpathian system of the Ukrainian SSR from the L'vov, Uzhgorod*, Kosov, Mezhgor'ye, and Rakhov, from seismological stations at Kishinev in the Moldavian SSR and Chernovits at the Chernovits State University, stations in the Crimean system and also seismological stations in Bulgaria, Hungary, Romania, Poland and Czechoslovakia.

As the result of the processing, the coordinates and other basic seismic data were obtained for 20 earthquakes, which are contained in the catalog, and their epicenters are entered on the map (see diagram).

In accordance with the conditional division of the Carpathian zone into five regions [1, 2], the Carpathian earthquakes in 1973 were concentrated in three regions: Northwest (No 1), Vrancha (No 2) and Banat (No 3). In the first zone five earthquakes occurred, two of which were in the Marmarosh-Sigeta region and three in the Turulung region on Romanian territory. Twelve earthquakes were recorded in the second: 11 deep ones (H=110-170) were concentrated in the Vrancha mountains, and 1 was a surface earthquake in the Rymnikul-Serat region. In the third zone three earthquakes were recorded in the region of the city of Timishoary.

The coordinates of the epicenters of the earthquakes in region No 1, beginning with the eighth energy class, were determined mainly from data from the regional equipment of the seismological stations at Uzhgorod, Mezhgor'ye, Rakhov and Kosov, and some foreign ones (Deva, Kympulung, Nedzina, Ks'onzh, Pishkestety). In this case methods of Hyperboles according to the direct P-waves were used (velocity V_p was taken as 5.7 km/sec). Intersections in accordance to the difference in the S-waves and P-waves were made for control.

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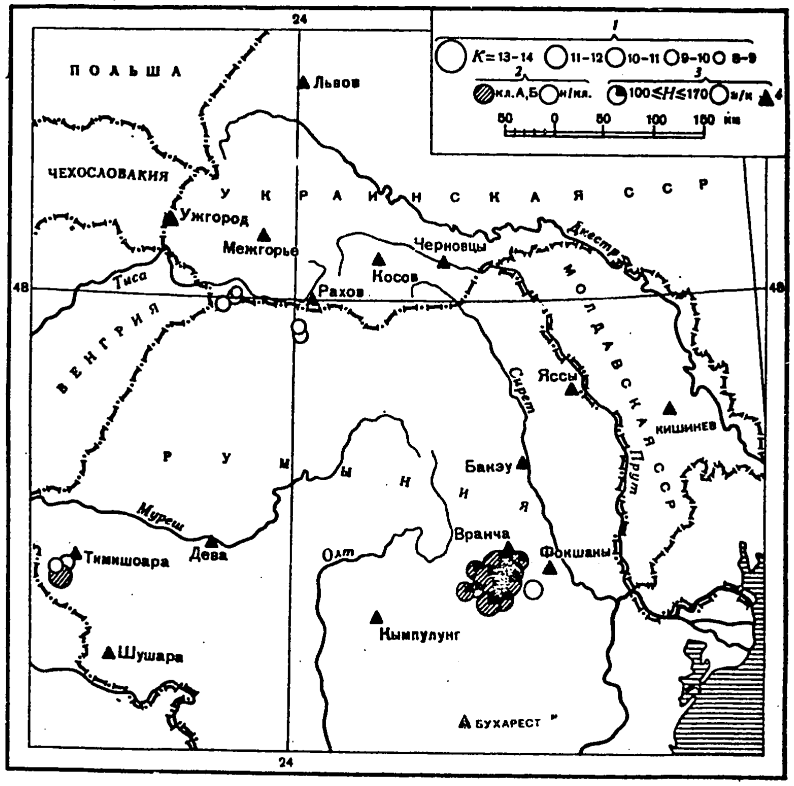
* At the seismological station at Uzhgorod regional instruments were installed in a pavilion at Onokovtsy, 6 kilometers northeast of the station.



Map of the Epicenters of Earthquakes in the Carpathians

1--energy of the earthquakes; 2--accuracy of epicenter determination; 3--depth of the focus, in kilometers 4--seismological stations

The coordinates of the epicenters of region No 2 were determined by the epicentral method of S. V. Yevseyev. For earthquakes with $K \leqslant 10$, the data from the Romanian and Carpathian networks of stations were used, as well as of the seismological station at Kishinev in the Moldavian SSR; seismological stations in the Crimea, as well as foreign ones--in Bulgaria, Hungary, Poland and Czechoslovakia--took part in determining the coordinates of earthquakes with $K > 10$.

When the coordinates of region No 4 were determined, a difficulty arose in identifying the phases of weak surface earthquakes (with K=10-11), since there were no data from the nearby Romanian stations of Timoshoar and Shushar.

Earthquakes were classified with respect to the accuracy of determining the coordinates according to the Atlas of Earthquakes in the USSR.

The energy class of the surface earthquakes was established according to the recordings of the body waves at seismological stations in the Carpathian network in the Ukrainian SSR (basic parameters of the operating equipment are given in the collection [3].

For deep earthquakes in the Vrancha region the energy class was established according to the distance of the registering, using data from the bulletins of stations in the Crimean system.

The strongest earthquakes occurred in the Vrancha region (K=11-14), five of which were felt in Kishinev with an intensity of 2-3 points (Nos 1, 3, 5, 6 and 8). The strongest was the earthquake on 20 August at 15:18. The energy class of this earthquake, according to data from stations in the Crimean network, was K$\sim$14, and the magnitude, according to the data from bulletins of the seismological station at Kishinev, was M=5.2.

A characteristic feature of the seismicity in the Northwestern region in 1973 was the weakening of the seismic activity in the Marmarosh-Sigeta region, which in 1971 had been quite high with respect to the number and intensity of the earthquakes (13 earthquakes with K=8-11, and of them, two earthquakes were felt on our territory in Transcarpathia with an intensity of 4-4.5 points). In 1973 the epicenters of two earthquakes (K$\sim$9) could be determined here.

The two epicenters of the earthquakes in Turulunga on 8 April at 01:24 and 01:29 were located on Romanian territory in the boundary strip. No earthquakes were recorded directly on our territory in Transcarpathia.

Catalog of Earthquakes in the Carpathians in 1973

№ п/п	Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	Класс точности	m_{PV}	K	№ района	Макросейсмические данные
			φ°N	λ°E						
1	2	3	4	5	6	7	8	9	10	11

Key:

1. Number, in order
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ°N
5. Coordinates of epicenter: λ°E
6. Focal depth, km
7. Accuracy class
8. m_{PV}
9. K
10 Number of region
11. Macroseismic data

1	2	3	4	5	6	7	8	9	10	11
				January						
1	5	12 37 48	45,5	26,5	130	А		12	2	Кишинев, 3 балла
	25	05 29 12	45,7	26,7	150	Б	3,7	10–11	2	
				February						
	19	20 13 34	45,6	26,3	150		3,3*	10	2	
	25	01 59 02	45,6	27,0		Б		10,5	2	
				March						
	12	09 56 47	45,6	26,2	140	Б		10–11	2	
	26	15 43 48	47,9	23,1		Б		9,0	1	
2	31	23 34 08	45,7	26,7	140	А		11–12	2	
				April						
	8	01 24 32	48,0	23,2		А		9,5	1	
	8	01 29 00	48,1	23,2		Б		8,5	1	
				August						
3	20	15 18 28	45,7	26,5	110	А	5,2*	14	2	Кишинев, 3 балла
4	23	14 52 39	45,6	21,1				11,5	4	
	23	16 56 24	45,6	21,1				10,0	4	
	23	18 24 39	45,7	21,2				10,0	4	
				September						
5	7	19 37 52	45,7	26,6	140	Б	4,9	13	2	Кишинев, 2–3 балла
	20	07 36 41	47,7	24,1				9,0	1	
				October						
6	23	10 51 58	45,6	26,7	170	А	5,0	13	2	Кишинев, 3 балла
7	25	01 19 18	45,5	26,6	130	Б	3,8	11	2	
				November						
	18	01 36 48	45,8	26,8	110	Б		10–11	2	
				December						
8	21	02 46 35	45,5	26,5	150	Б		12	2	Кишинев, 2 балла
	24	05 27 39	47,8	24,0				9	1	

* According to the data from the 10-year bulletin of the seismological station at Kishinev. In the rest of the cases, as an average from several stations.

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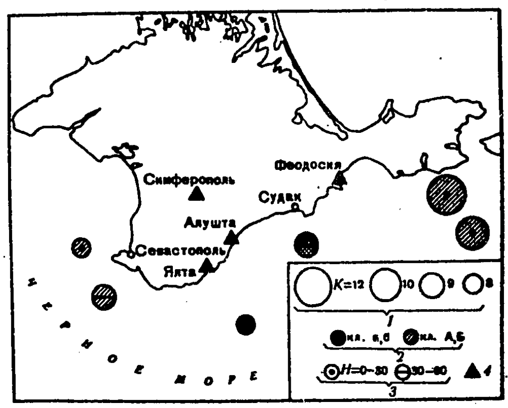
EARTHQUAKES IN THE CRIMEA

I. B. Dubinskiy, S. A. Kapitanova, I. I. Popov

The Crimean seismological system in 1973 consisted of four seismological stations: Simferopol', Yalta, Alushta and Feodosiya.



Map of the Epicenters of Earthquakes in the Crimea

1--energy of the earthquakes; 2--accuracy of determining the epicenter; 3--depth of the focus, in km; 4--seismological stations

The coordinates of the epicenters of nearby earthquakes were determined by the method of cross bearings according to the travel time curve of A. Ya. Levitska [1], and the energy class was estimated according to the nomogram of Z. I. Aranovich [2] and more precisely defined by V. Ye. Kul'chitskiy and V. G. Pustovitenko [3]. In processing the earthquakes in the Black Sea and southwest of Feodosiya, the Jeffreys-Bullen travel time curve and the energy nomogram of T. G. Rautian were used [4].

The principal focal zones of the Crimean region are characterized by weak seismic activity in 1973. Negligible reactivation was noted in the region east of Feodosia. An earthquake occurred here on 20 February with K=12, and on 16 August with K=10 (see diagram).

Catalog of Earthquakes in the Crimea in 1973

Дата	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	Класс точности	K	Район
		φ°N	λ°E				
1	2	3	4	5	6	7	8

Key:
1. Date
2. Moment of origin, hrs, mins, secs
3. Coordinates of epicenter: φ°N
4. Coordinates of epicenter: λ°E
5. Focal depth, in km
6. Accuracy class
7. K
8. Region

20.II	11 38 53	44,90	36,35	В земной коре*	A	12	Восточнее Феодосии
6.VI	21 29 23,5	44,63	35,12	40	б	9	Юго-восточнее Судака
20.VI	23 11 36	44,17	34,55	10–20	б	8	Ялтинско-Алуштинская зона
9.VII	15 14 44,5	44,3	33,3	40	A	9	Севастопольская зона
13.VIII	17 43 36,5	44,6	33,1	10–20	A	8	То же
16.VIII	09 41 (44)	44,7	36,6	В земной коре*	A	10	Юго-восточнее Феодосии

* In earth's crust

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EARTHQUAKES IN THE CAUCASUS

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On the territory of the Caucasus zone, bounded by the coordinates 38–45° N lat and 38–52° E long, observations were made at 35 seismological stations, of which 28 were equipped with instruments with increased sensitivity. The list of seismological stations in the Caucasus region, with an indication of the equipment, is given in work [1]. Three new field seismological stations were opened in 1973, and the data on the equipment for them is given below.

Parameters of Newly Opened Seismological Stations

(1) Станция	(2) Тип аппаратуры	V_m			T_m
		Z	E–W	N–S	
(3) Шеки	(6) СКМ-3	15 300	16 300	16 300	0,2–1
(4) Каджарян	СКМ-3	10 300	10 300	10 300	0,2–0,5
	(7) СКД	1 020	1 020	1 020	0,2–21,0
	(8) СМТР	–	8,6	–	2–5
(5) Анапа	СКМ-3	25 000	25 000	25 000	0–0,5

Key:

1. Station
2. Type of equipment
3. Sheki
4. Kadzharyan
5. Anapa
6. SKM-3
7. SKD
8. SMTR

The curves of increase in the equipment at the seismological stations in the Caucasus in 1973 are given in [2].

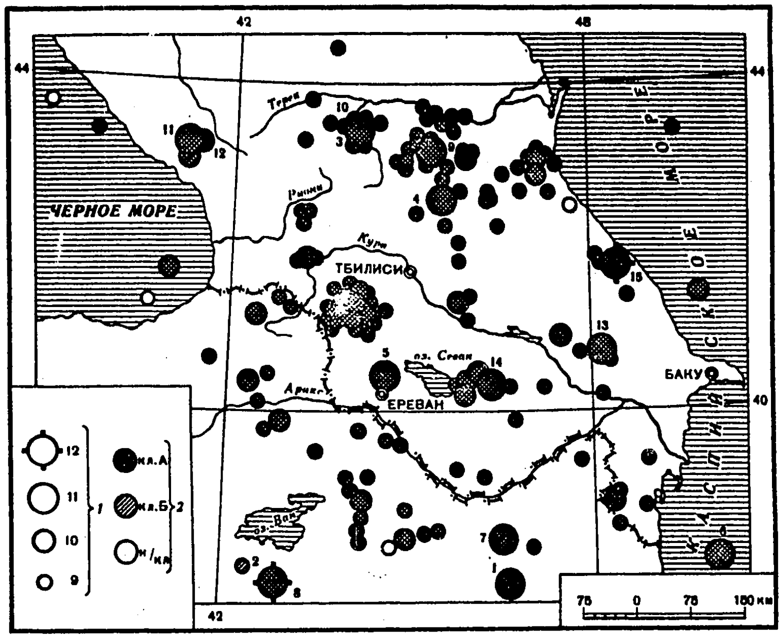

Figure 1. Map of the Epicenters of Earthquakes in the Caucasus With K$\geqslant$ 9

1--energy of the earthquakes; 2--accuracy of epicenter determination

The coordinates of the hypocenters of earthquakes in 1973 were mainly determined by the method of intersections, using travel time curves, plotted for the Caucasus and the Dzhavakhetskoye uplands. The coordinates of the hypocenters of the Turkish and Iranian earthquakes located over 100 kilometers from the state boundary were found with the aid of the Jeffreys-Bullen travel time curves. In some cases epicentral, isochronal and halving line methods were used. When the composite bulletin was prepared, in addition to data from the observations of the Caucasian stations, data from the Operations Seismological Bulletin of the Institute of Physics of the Earth of the USSR Academy of Sciences and bulletins from Turkey, Poland and Finland were used.

In 1973 epicenters for a total of 735 earthquakes were determined in the Caucasus, with the distribution by energy for the entire Caucasus, its eastern section and the Dzhavakhetskoye uplands given below:

K	5	6	7	8	9	10	11	12	Total
Number of earthquakes:									
Caucasus	2	53	237	287	115	26	13	2	735
Eastern Caucasus	-	-	23	68	23	4	2	-	120
Dzhavakhetskoye uplands	2	40	85	37	7	5	-	-	176

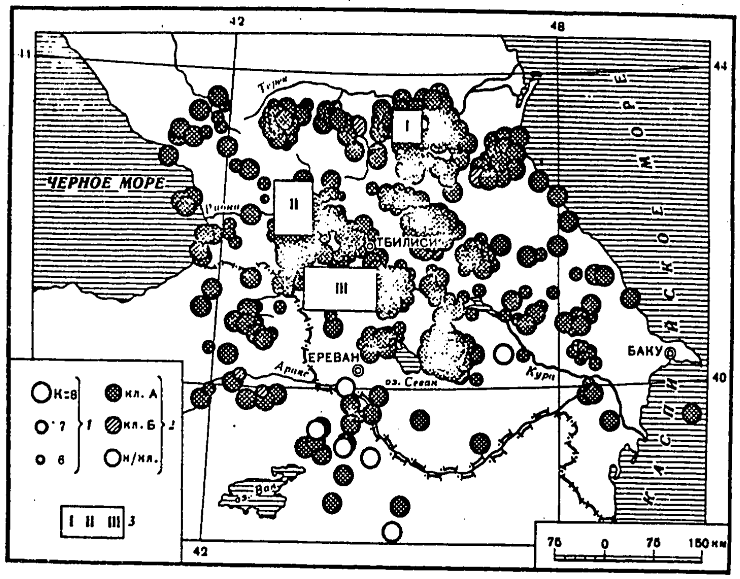

Figure 2. Map of Epicenters of Earthquakes in the Caucasus With K ⩽ 8

1--energy of the earthquakes; 2--accuracy of determining epicenters; 3--number of earthquakes in area: I--15 with K=8 and 9 with K=7; II--18 with K=8, 18 with K=7.8, with K=6; III--38 with K=8, 80 with K=7, 32 with K=6, 1 with K=5

The catalog has data on the basic parameters of the focal points of earthquakes with K ⩾ 9. The detailed station data, on the basis of which these parameters were determined, were published in [3]. In order to study the special characteristics of the location of the earthquake focal points, two maps of epicenters were plotted: on the first are mapped the epicenters of earthquakes with K ⩾ 9 (Fig. 1), and on the second--with K=6.8 (Fig. 2). As can be seen from these maps, in 1973 a large cluster of epicenters is observed on the territory of the Dzhavakhetskoye uplands and the Eastern Caucasus. The numbers of the regions on the map are indicated in accordance with the division of the territory of the Caucasus given in [1].

The seismic activity of the Caucasus in 1973 is comparable in level with the activity in 1972. The most significant seismic event in 1973 was the earthquake in the Yerevan region on 16 June at 08:59 (No 5). It appeared with a maximum intensity of 5.5 points north of Yerevan. In order to ascertain the macroseismic aftereffects of this earthquake, the central part of Yerevan, the Norskiy tract and the Zeytunskiy and Agapiyakskiy regions of the city were studied. It was revealed that strong damage was inflicted only on the structures which had been dilapidated before the earthquake (Fig. 3).

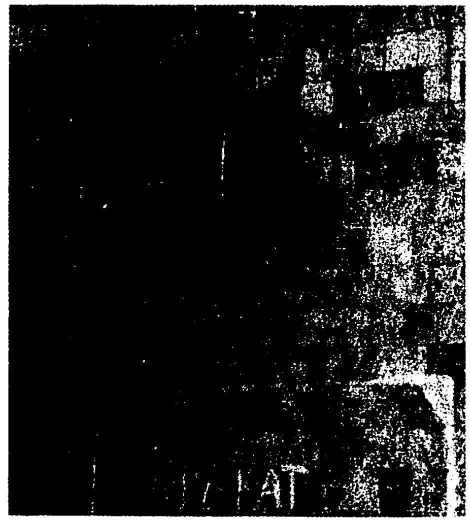

Figure 3. Damage to a Building in Yerevan During the Earthquake on 16 June 1973.

Hairline cracks in the concrete aggregates were revealed in the upper floors of some tall buildings in the area of the Zeytun and Norkskiy tract. In the city of Parakar the earthquake was felt by many people in buildings and in courtyards in the form of vibrations and shaking of the ground. In the settlement of Sovetashen both the shaking of the ground and a wavelike vibration of the soil was observed. Doors and windows shook, light objects were shifted and dishes clattered. A wavelike vibration of the ground was felt in the settlement of Vedi. In the city of Ashtarak a jolt was noted that awoke people from sleep. Light objects fell and the clinking of dishes was heard. At the Sovkhoz imeni Bagramyan, the earthquake appeared in the form of a wavelike vibration of the ground. Doors and windows shook, and opened and closed. In the city of Echmiadzin one jolt was felt. Hanging objects vibrated, and light objects shifted from their place and fell down. In the village of Voskevoz a wavelike vibration of the ground was noted. Doors and windows shook, light objects shifted and the clinking of dishes was heard.

The recording of the earthquake on 16 June at 08:59 at the seismological station at Leninakan is shown in Figure 4. Additional information on this earthquake may be found in the article [4].

On 27 June, at 23:24, on the territory of the eastern part of the Lesser Caucasus an earthquake occurred which was felt with maximum intensity of 5 points at the centers: Taknali, Ili, Bandivan and Baytar; at Gukasyan, Amasiya, Zuykakhpyur, Kondzhali and Torosgyukh--4-5 points at Leninakan, Keti, Gyulubsulakh, Kazanchi, Sogatly-Muaelian--4 points; at Aykavan, Kuzikyand, Arapa, Bavra--3-4 points; at the villages of Dzhadzhur, Luysakhpyur, and Gyullidzha--3 points. The macroseismic epicenter of the Gukasyanskoye earthquake is located between Taknali and Ili. The pattern of isoseismic lines is shown in Figure 5. Additional information on this earthquake is given in work [5].

Brief data on the macroseismic manifestations of individual earthquakes in 1973 are in the catalog.

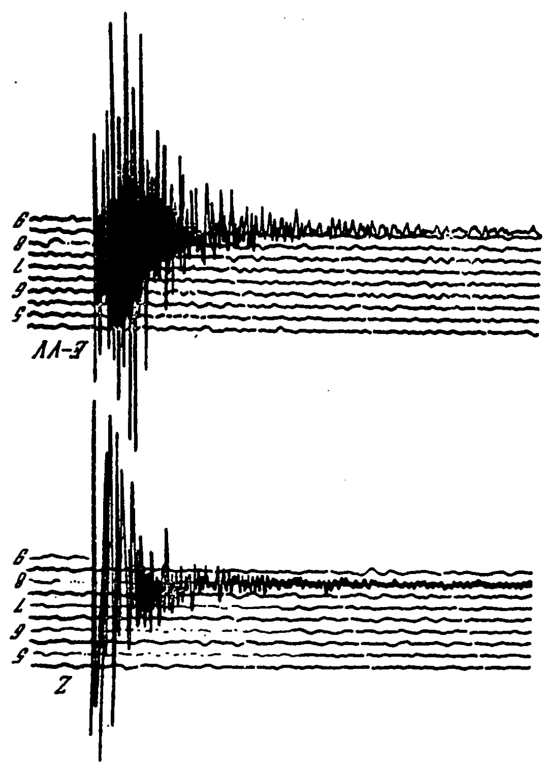

Figure 4. Recording of the Earthquake on 27 June 1973 at the Leninakan Station with a SKM-3 Instrument

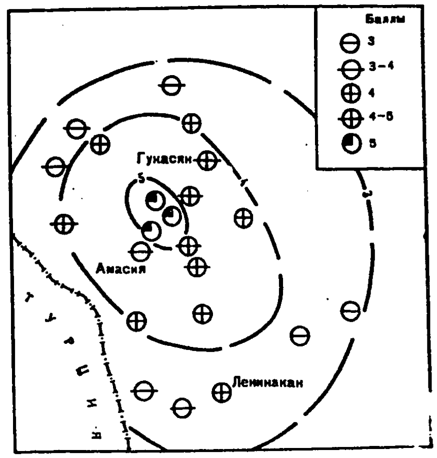

Figure 5. Macroseismic Map of the Gukasyanskoye Earthquake on 27 June 1973. Compiled by A. Kh. Bagramyan, Z. G. Geodakyan, V. G. Papalashvili.

Catalog of Earthquakes in the Caucasus With K ⩾ 9 in 1973

№ п/п	Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	Класс точности	M	K	№ района	Макросейсмические данные
			φ°N	λ°E						
1	2	3	4	5	6	7	8	9	10	11

Key:

1. Number, in order
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ °N
5. Coordinates of epicenter: λ °E
6. Focal depth, in km
7. Accuracy class
8. M
9. K
10. Number of region
11. Macroseismic data

January

1	20 41 08,0	43,3	45,2		A	9	13	Грозный, 4 балла
2	21 02 29,2	40,2	45,8		A	10	8	Варденис, 5 баллов; Горис, 4,5 балла

1	2	3	4	5	6	7	8	9	10	11
	3	00 54 33,1	43,4	39,5		А		9	10	Сочи, 3–4 балла
		03 24 30,5	39,0	48,4		А		9	14	
	4	14 51 43,1	43,3	39,5		А		9	10	Сочи, 4 балла
1	6	15 39 27,5	37,8	46,6		А	4,2	11	17	Ленкорань, 5 баллов; Горис, 4–5 баллов
	7	17 46 43,8	38,3	47,0		А		9	17	
	11	20 51 26,6	43,6	38,6		А		9	10	
	13	00 16 17,9	41,33	44,07	0–10	а		9	6	Дманиси, 4 балла
	15	10 44 28,3	40,7	48,3		А		10	7	
	21	10 17 01,5	40,3	45,9		А		9	8	
	22	05 38 03,7	42,7	46,8		А		9	3	
		23 00 03,6	42,7	45,7		А		9	3	
	24	20 15 00,0	43,1	47,0		А		9	3	
	26	07 15 19,9	42,1	45,7		А		9	3	
		17 54 20,5	38,5	45,2		А		9	17	
	27	12 17 54,4	39,9	46,7		А		9	8	
	28	20 54 54,5	41,20	43,97	0–10	а		9	6	
2	30	07 52 19,0	38,1	42,4		Б	3,8	11	16	
		14 08 38,9	43,6	45,3		А		9	13	
				February						
	6	12 14 28,6	44,4	43,5		А		9	12	
	7	08 51 57,7	41,17	42,9	0–10	б		9	16	
	9	02 54 49,5	38,7	44,0		А		9	16	
	11	16 03 13,5	39,4	48,9		А		9	7	
	13	23 54 38,5	42,6	46,2		А		9	3	
	14	17 25 38,4	39,8	42,6		А		9	16	
	17	07 10 16,4	41,18	44,48	0–10	б		9	8	
	21	00 24 10,2	40,3	42,3		А		10	16	
		02 55 52,5	40,2	48,2		А		9	7	
		16 47 58,1	42,9	47,1		А	3,6	10	3	
	28	09 54 47,2	41,3	42,7		А		9	16	
				March						
	1	21 54 10,4	40,7	47,8		А		9	7	
	2	05 53 16,4	41,1	42,4		А		10	16	
	3	08 50 39,6	41,27	44,05	0–10	а		10	6	
		09 17 34,0	41,27	44,03	0–10	б		9	6	
		14 49 23,9	40,4	42,6		А		9	16	
	11	08 55 13,3	41,37	44,03	0–10	а		10	6	Дманиси, 4 балла
		08 59 45,7	41,41	44,08	0–10	а		10	6	" "
	13	11 18 59,9	43,0	45,5		А		9	3	
	14	06 18 52,5	43,0	46,8		А		9	3	
	29	22 34 54,8	42,7	47,3		А		9	3	
				April						
	6	05 46 30,8	39,4	47,8		А		9	17	
	8	20 31 58,7	41,6	40,9	20	А		10	10	
	15	07 30 15,9	38,5	44,1		А		9	16	
		09 08 34,5	38,4	44,2		А		9	16	
		11 58 48,4	43,6	45,2		А		9	13	
		19 22 12,8	42,6	46,3		А		9	3	

1	2	3	4	5	6	7	8	9	10	11
	16	01 04 50,4	42,6	46,3		A		9	3	
	20	14 10 24,4	43,1	44,8		A		9	2	
	22	17 18 13,6	41,13	44,01	0–10	б		9	6	
		21 01 10,2	43,1	45,8		A		10	13	Грозный, 5 баллов
		21 27 48,2	43,2	45,9		A		9	13	
	25	05 08 23,7	40,3	46,6		A		9	8	
	28	18 30 16,0	41,8	48,3		A		9	3	
	30	13 16 19,7	43,4	43,9		A		9	13	
3		14 09 31,4	43,4	43,9	15	A	3,9	11	13	
		15 48 19,4	43,4	43,9		A		9	13	
		15 53 00,8	43,4	43,9		A		9	13	
					May					
	3	22 16 37,7	43,5	43,4		A		9	2	
	6	19 58 21,3	40,1	42,5		A		9	16	
	7	03 17 23,1	43,5	44,3		A		9	3	
	9	20 53 16,9	42,3	46,4		A		9	3	
	14	15 10 11,3	41,30	44,05	0–10	a		10	6	Дманиси, 4 балла
	15	14 38 55,7	38,9	44,2		A		10	16	
	16	05 48 58,1	42,38	43,05		б		9	2	Ткибули, Цхалтубо, 3–4 балла
4	19	21 50 33,6	42,6	45,4		A	4,1	11	3	Душети, Базалети, 3–4 балла
	21	03 51 35,1	43,2	45,3		A		9	13	
	23	00 49 19,2	38,6	48,4		A		9	14	
	28	20 56 41,1	39,0	44,0		A		9	16	
	30	04 22 17,8	43,4	45,1		A		9	13	
					June					
	1	09 35 45,8	41,37	43,97	0–10	б	3,3	10	6	Богдановка, 4 балла
	3	23 09 33,7	43,4	45,1		A		9	13	
	13	01 23 50,8	40,4	46,1		A		10	8	Кировабад, 3 балла
5	16	08 59 08,3	40,4	44,5	20	A	3,7	11	9	Ереван, 5–6 баллов
	22	23 06 18,7	38,4	44,9		A	3,4	10	17	
	27	17 19 09,7	41,3	43,9	0–10	A		9	8	
		23 24 30,2	41,1	43,9	0–10	б		10	8	See text
	30	20 07 23,8	41,23	44,05	0–10	б		9	6	
					July					
	1	23 11 17,0	42,9	46,5		A		9	3	
	2	23 10 23,5	41,30	43,78	0–10	б		9	6	
	3	04 15 01,0	40,8	50,8		A		9	11	
	4	16 26 25,6	38,8	44,9		A		9	17	
	8	21 11 28,2	41,4	45,9		A		9	7	
	9	20 42 21,2	40,9	44,2		A		9	8	
	11	09 02 05,0	42,4	45,0		A			3	
	12	13 33 10,6	39,2	43,9		A		9	16	
6	13	10 05 13,0	38,1	49,9		A		11	11	
	17	04 33 04,4	43,5	45,4		A		9	13	
	18	14 46 12,3	42,3	45,5		A		9	3	
	20	02 36 42,0	39,7	50,8		A		9	11	
	22	09 34 08,0	39,8	44,1		A		9	16	

1	2	3	4	5	6	7	8	9	10	11
	25	23 02 22,9	41,08	43,87	0–10	б		9	8	
	26	00 44 58,3	41,08	43,88	0–10	б		9	8	
		02 15 00,6	41,11	43,93	0–10	б		9	8	
	27	06 00 55,6	41,9	48,1		А		9	3	
7		22 24 39,4	38,4	46,5		А	4,0	11	17	
	30	07 30 11,7	43,4	45,6		А		9	13	
					August					
	4	08 15 55,7	43,1	47,2		А		10	3	
		20 29 57,1	38,8	48,8		А		9	14	
	6	21 21 36,3	43,0	47,0		А		9	3	
	10	04 11 12,0	43,1	45,2		А		9	13	
	11	18 41 45,7	39,3	45,7	35	А		9	8	
	13	18 22 25,4	41,48	43,67	0–10	б		9	6	
	15	13 14 11,4	42,8	45,4		А		9	3	
	17	13 10 25,0	41,8	45,7		А		9	3	
	22	09 39 04,7	42,5	47,7				9	3	
	26	09 30 54,6	38,3	44,7			3,5	10	17	
	28	07 24 59,6	39,6	44,8		А		9	16	
	29	04 31 02,6	43,4	43,9		А		9	13	
		15 12 35,5	43,4	43,8		А		9	13	
8	30	07 37 21,0	37,9	42,8		А	5,2	12	16	
		19 23 31,4	43,8	43,1		А		9	2	
9	31	04 57 10,8	43,2	45,2		А	4,0	11	13	
					September					
	3	08 19 37,5	41,3	45,7		А		10	7	
	4	01 50 11,2	38,9	48,3		А		10	14	Ленкорань, 4 балла
		04 50 44,5	38,5	45,4		А		9	17	
	6	10 04 46,4	41,80	43,11	0–10	а		10	5	
		10 11 36,3	41,80	43,11	0–10	б		10	5	
10	8	06 58 46,2	43,5	43,9		А	4,0	11	13	Нальчик, 5 баллов
	12	01 04 37,2	41,85	43,17		а		9	5	
	15	22 43 42,2	39,9	42,8		А		10	16	
	19	18 16 33,8	42,37	43,07		б		9	2	Ткибули, 3–4 балла
	23	16 27 46,6	43,	45,9		А		9	3	
					October					
11	3	09 24 42,1	43,2	41,1		А	4,2	11	1	Сухуми, 4 балла
		10 00 25,3	43,13	41,07		б		10	1	
12		11 38 30,2	43,21	41,10		б	3,8	11	1	
	10	04 45 27,4	41,4	48,6		А		9	3	
	15	19 11 26,0	43,7	45,1		А		9	13	
	17	04 35 08,1	41,1	45,9		А		9	7	
	18	19 19 40,2	43,2	45,2		А		9	13	
	23	09 09 43,1	41,4	49,8		А		10	11	
	26	00 17 33,5	40,9	47,5		А		10	7	
13		13 11 49,0	40,7	48,2		А		11	3	
		16 40 16,2	41,2	40,6		А		9	10	
	27	02 14 42,1	43,1	44,8		А		9	13	

1	2	3	4	5	6	7	8	9	10	11
					November					
	3	03 54 09,4	39,2	41,6		Б		9	16	
	10	01 14 41,3	39,2	44,3		A		9	17	
	11	03 02 04,7	39,7	44,6		A		9	17	
	22	04 34 44,7	43,6	45,6		A		9	13	
		11 41 00,1	43,6	45,8		A		9	13	
		18 11 33,0	40,3	47,2		A		9	7	
					December					
	1	08 38 37,8	39,5	43,4		A		9	16	
	5	12 57 39,9	43,3	43,0		A		9	2	
14	6	01 15 00,6	40,3	46,3	15	A		11	8	See separate article
		02 37 11,1	43,0	47,4		A		9	3	Махачкала, 4 балла
	8	05 37 26,8	42,4	43,1		A		9	2	Ткибули, 4 балла
	13	04 05 50,0	39,2	46,2		A		9	8	
15	14	09 11 46,0	41,9	49,0	75	A	5,4	12	11	Насосное, 3–4 балла
	17	00 56 52,1	40,6	41,7		A		9	16	
	18	01 18 02,8	43,0	47,0		A		9	3	
	26	09 04 14,0	43,2	45,2		A		9	13	
	27	11 30 20,8	43,0	44,7		A		9	2	
	28	20 37 46,5	40,3	45,9		A		9	8	

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MARDAKERT EARTHQUAKE ON 6 DECEMBER 1973

V. P. Kuznetsov

On 6 December 1973 at 01:15:06 Greenwich time an earthquake with K=11 occurred, which was felt in the mountain population centers located in the vicinity of the banks of the Terter and Gyandzha rivers and others. The basic parameters of the earthquake were: φ=40.3°N, λ=46.4°E, and the depth of the focus was 5 kilometers. The earthquake was accompanied by a single aftershock. Information on the origin times of the P and S waves, as well as on their amplitude (A) and period (T) are given in the table. The readings were made from the recordings of the earthquake at temporary stations equipped with VEGIK instruments and registers with a time base of 120 mm/min.

Instrument Information

(1) Станция	(2) Вступления волн			S–P, сек (6)	Δ, км	T_S, сек	A_S, мк		K
	(3) час, мин	P, сек (4)	S, сек (5)				N–S	E–W	
(7) Кельбаджар	01 15	i 9,6	i14,6	5,0	37	0,35	4,9		11
(8) Зурнабад	01 15	i 10,2	i15,0	4,8	37				
(9) Джафархан	01 15	i 30,8	53,5	22,7	178	0,60		1,43	
	01 15	i $\bar{P}$32,0	55,0						
(10) Сальяны	01 15	i 41,5	i 69,5	28,0	224	0,06	0,45		

Key:

1. Station
2. Wave origin
3. Hours, minutes
4. P, in seconds
5. S, in seconds
6. S-P, in seconds
7. Kel'badzhar
8. Zurnabad
9. Dzhafarkhan
10. Sal'yany

The geological conditions were represented mainly be the adjusted state of the Shamkhorskiy, Geygel'skiy, Mrovdagskiy and Karbakhskiy anticlinoria, where the fold formation has been destroyed by granitoid intrusions which originate primarily in the anticlinal parts of structures formed by Middle Jurassic volcanogenic strata.

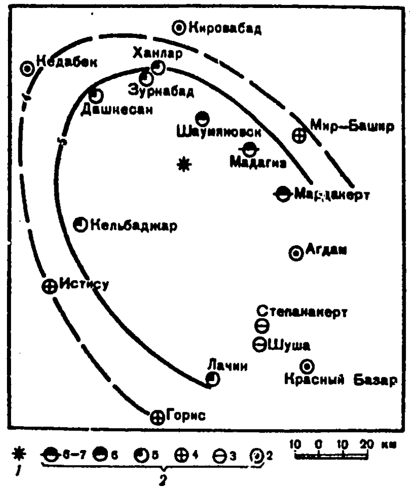

Diagram of Isoseismal Lines of the Mardakert Earthquake on 6 December 1973. Drawn Up by V. P. Kuznetsov

1--epicenter according to instrument data; 2--intensity

Against this background of anticlinoria, the Dashkesano-Zurnabad intrusion (synclinorium of the same name) stands out. The Dashkesan synclinorium and intrusion were extended in a latitudinal direction and cut the surrounding rock. The latter is the criterion for singling out a fault that lies deep.

It is not simple to solve the problem of the rearrangement of an old structure of rocks and the new formations due to the change in the surrounding rock by intrusions.

Relatively low thickness is shown by the granitoid intrusion of Uchtap and Kizilkay, located on the southern outskirts of the city of Kirovabad, in the region of the boulder-gravel deposits of the alluvial fan of the Gyandzhachay River, along both sides of it.

The manifestations of volcanism complicated the formation of the geological structures. For example, with the slight thickness of the sedimentary rock, volcanogenic formations have developed widely in the form of lava beds, andesites, andesite-basalts and intrusions.

Macroseismic Information

Mardakert-Madagiz (6-7 points). During the earthquake, in houses built of stonework, cracks appeared in the walls and arches for the ceiling and plaster crumbled; tiles fell from the roofing, doors and windows shook and banged, hanging objects swayed wildly, household items shifted and water splashed out.

Zurnabad (5 points). Two jolts were felt. Lamps swayed slightly, doors and small windows opened, the floors and ceilings creaked, window panes jarred, and dishes rattled. Underground rumbling was also heard. People left their houses. The head of the seismological station, Ch. M. Mustafayev, reports that a gust of wind rushed over the village (from the direction of the village of Dashkesan) and immediately died down. There were no damages to the buildings.

Khanlar (5 points). Hanging objects swayed slightly and dishes rattled. A vertical jolt was noted, and then a wavelike vibration; for 3-4 seconds an easily discernible slight sound was heard. People were awakened; some from the jolt and others from the rumble. There was no damage to the buildings.

Kel'badzhar (5 points). In some houses cracks appeared, plaster came off, furniture shifted and dishes fell off the table. Cracks running from north to south, up to 2 centimeters wide, were formed in the ground. Many people determine the direction of the vibrations toward Mardakert. There were analogous observations at Shaumyanovsk.

Dashkesan (5 points). Many people felt the earthquake as a jolt, and a loud rumble was heard, coming from the south, lasting up to 3 seconds; people left their quarters. Dishes clattered.

Lachin (5 points). The ground was observed to vibrate; dishes clattered and pendulum wall clocks stopped; a jerky, prolonged rumbling was heard.

Istisu, Mir-Bashir, Goris (4 points). The earthquake was manifested in the form of wavelike vibrations, and people sleeping woke up; chandeliers swayed slightly.

Shusha, Stepanakert (3 points). Most people felt the earthquake in the form of vibrations. Some people (who were sleeping) did not feel the earthquake.

Kirovabad, Agdam, Krasnyy Bazar, Kedabed (2 points). Many people did not notice the earthquake.

The macroseismic manifestations of this earthquake are shown on the map-diagram. The intensity was estimated in accordance with work [1].

The author is grateful to E. G. Giodakyan, head of the seismological station at Leninakan, for the information on the earthquake.

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EARTHQUAKES AT KOPET DAG

G. L. Golinskiy, K. D. Lagutochkina, A. R. Rakhimov

In 1973, materials on earthquakes in the Kopet Dag seismic zone, bounded by the coordinates 36-42° N lat. and 52-62° E lon., were obtained from the data of seven seismological stations: two reference (Ashkhabad and Kizyl-Arvat) and five regional (Vannovskaya, Kara-Kala, Kizyl-Atrek, Krasnovodsk, Nebit-Dag). The observations of the earthquakes were considerably improved due to the continuing work on expanding the network of seismological stations. The information on the seismicity of the zone was supplemented by new temporary regional stations: Kaakhka, monitoring the seismicity of Eastern Kopet Dag and Northeast Iran (Meshkhedskiy Rayon); Bakhardok, located in the Central Kara-Kum, and also by an expeditionary observation point at the meteorological station at Chagyl, provided with seismic equipment to register earthquakes in the northwestern regions of the Kara-Kum sands, adjacent to the Krasnovodsk plateau and the Kara-Bogaz-Gol Gulf.

The location of the seismological stations is shown in Figure 1, and the parameters of the instruments of the principal stations are given in work [1].

The present positioning of the stations has ensured approximately uniform coverage of the seismic situation in all the regions of the zone for earthquakes with an energy level of $K \geqslant 11$. Reducing the level of representativeness of the earthquakes recorded to $K \leqslant 10$ requires that the distances between the stations, which now reaches 150-200 kilometers, be cut in half.

For differentiated study of the seismicity and ascertaining of the regional differences in the seismic conditions, the territory of the Kopet Dag zone has been conditionally divided into seven regions, differing in geological formation and seismotectonic conditions: 1--the eastern part of the water area of the Caspian Sea, encompassing the Kara-Bogaz-Gol Gulf; 2--the Krasnovodsk plateau, outlined at the west and southwest by the Caspian Sea, and on the north--by the coastal area of the Kara-Bogaz-Gol Gulf; 3--the Caspian lowlands, adjacent on the west to the Caspian Sea, with inclusion of the Gorgansk region of Northern Iran; 4--the Kara-Kum sands; 5--the

Cis-Kopet Dag foredeep; 6--Kopet Dag, including the northern province of Iran, Khorasan; 7--the southern part of Northern Iran.

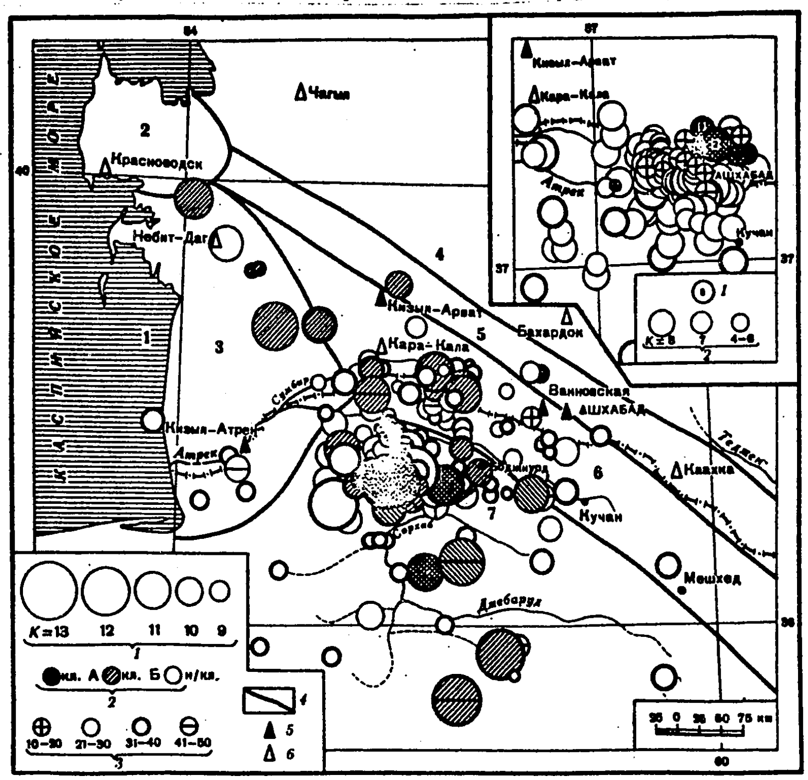

Figure 1. Map of Epicenters of Earthquakes in Kopet Dag With K ⩾ 9. Drawn Up by K. D. Lagutochkina.

1--energy of the earthquakes; 2--accuracy of determining the epicenter; 3--depth of the focus, in km; 4--boundary of the regions; 5--permanently operating seismological stations; 6--temporary. In the inset: map of the epicenters of earthquakes with K=4-8. 1--number of epicenters at same point; 2--energy of the earthquakes. For other designations see the main map.

The seismic observations were made by the Laboratory of Regional Seismology of the Institute of Physics of the Earth and Atmosphere of the Turkmen SSR Academy of Sciences. In addition to the authors, associates of the laboratory N. A. Makarenko and A. K. Musayeva, headed by K. D. Lagutochkina, processed the instrument data. An analysis and summarization of the data from the processing were performed by G. L. Golinskiy and K. D. Lagutochkina and A. R. Rakhimov supervised the instrument observations.

Table 1. Distribution of Earthquakes by Energy Classes

	K										Всего (9)
	4	5	6	7	8	9	10	11	12	13	
(1) Землетрясения, для которых определены координаты эпицентров	6	12	22	42	56	59	41	15	4	5	262
(2) Местные землетрясения ($\bar{S}-\bar{P} \leqslant 10$ сек), отмеченные отдельными станциями:											
(3) Ванновская	1	–	17	42	27	10	1	–	–	–	98
(4) Ашхабад	–	–	–	5	10	9	3	–	–	–	27
(5) Кизыл-Арват	–	–	–	–	–	1	–	–	–	–	1
(6) Кизыл-Атрек	–	–	–	–	–	1	–	–	–	–	1
(7) Кара-Кала	–	–	–	–	1	–	–	–	–	–	1
(8) То же ($\bar{S}-\bar{P} > 10$ сек):											
(3) Ванновская	–	–	1	16	51	32	5	–	–	–	105
(4) Ашхабад	–	–	–	–	2	9	3	–	–	–	14
(7) Кара-Кала	–	–	–	–	2	3	1	–	–	–	6
(6) Кизыл-Атрек	–	–	–	–	1	4	5	–	–	–	10
(5) Кизыл-Арват	–	–	–	–	–	2	–	–	–	–	2
(9) Итого	7	12	40	105	150	130	59	15	4	5	527

Key:

1. Earthquakes for which epicenter coordinates were determined
2. Local earthquakes ($\bar{S}-\bar{P} \leqslant 10$ sec.), recorded by individual stations:
3. Vannovskaya
4. Ashkhabad
5. Kizyl-Arvat
6. Kizyl-Atrek
7. Kara-Kala
8. Same ($\bar{S}-\bar{P} > 10$ sec.)
9. Total

The methodology for processing the data on earthquakes in the Kopet Dag zone mainly remained similar to that used in preceding years. The method of intersections, using the travel time curve of Ye. A. Rozova was used in determining the coordinates of the epicenters [2]. Classification of the accuracy of determining the coordinates was adopted in accordance with the Atlas of Earthquakes in the USSR.

The energy class of the earthquakes was established according to Rautian's nomogram [3]. The magnitude of the earthquakes was determined from the surface waves. For more precise determination of the position of the epicenters of earthquakes with $M \geqslant 4$ ($K \geqslant 11$), recorded by more distant stations, the bulletins from seismological stations located outside the limits of Turkmeniya were drawn in: Baku, Samarkand, Tashkent, etc., as well as the data from the Operational Seismological Bulletin of the IFZ of the USSR Academy of Sciences.

In view of the special features of the existing positioning of seismological stations in the Kopet Dag zone, it is not possible to determine the depth of the focal points of the earthquakes by using the known instrument methods. For individual strong earthquakes in the zone ($M \geqslant 4$), the depth of the focal points was calculated on an electric computer from the data of seismological stations in the USSR and the world [4, 5].

In this work, for the first time the depths of occurrence of the focal points for all the earthquakes in the zone were determined according to the method of N. V. Shebalin [6], based on using the mean relation between the intensity at the epicenter I_0, the magnitude M and the depth of the earthquake :

$$I_0 = bM - \nu \lg h + c. \qquad (1)$$

The comprehensive study of the macroseismic and instrument data, made by G. L. Golinskiy through analyzing and summarizing the extensive information on earthquakes in Turkmeniya during a period of over 2,000 years, made it possible to determine the coefficients of the equation for the macroseismic field and to express the relation (1) in the following form:

$$I_0 = 1{,}5M - 3{,}8 \lg h + 3{,}5. \qquad (2)$$

From this it is possible to obtaine the magnitude of the value for the depth of the focal points of earthquakes in the Kopet Dag zone

$$\lg h = (1{,}5M - I_0 + 3{,}5) \,/\, 3{,}8. \qquad (3)$$

In this work the focal depths were determined according to the macroseismic data from a nomogram [7], constructed for convenience in computation in accordance with the equation (3).

As the result of using the method, it was established that in the case of a perceptible earthquake, the focus of which lies close to population centers, the error in the accuracy of determining its depth lies within a range of $1.1h \leqslant h \leqslant 1.5h$, and in the absence of information on the nature of the perceptibility of the vibration--within a range of $1.5h \leqslant h \leqslant 2h$.

In 1973 the network of seismological stations in Turkmeniya registered 527 earthquakes with K=4-13 according to Rautian's classification. A little over half of the total number of earthquakes--265, which is 50.3 percent--proved to be local and were recorded only by individual stations: 128 earthquakes (24.3%) occurred at epicentral distances with $\overline{S-P} \leqslant 10$ seconds, and 137 earthquakes (26%)--at distances with $\bar{S}-\bar{P} \geqslant 10$ seconds. Among the local earthquakes there are 18 jolts with K=10, but their epicenters were not determined, in view of the registering of the earthquakes only by nearby stations. The distribution of earthquakes registered, depending on the energy class, is given in Table 1.

The position of the epicenters for 262 earthquakes (49.7%) which occurred on the territory of the Kopet Dag zone and are given in the table, was determined. The spatial positioning of the focal points is depicted on the map of epicenters with an energy of K=9-13 (see Fig. 1), and of lower energy levels K=6-8, on the inset map of the same scale.

An analysis of the maps of the epicenters gives a general idea of the seismicity of the region. The distinguishing feature of the seismic activity of Kopet Dag in 1973 is the absence of strong earthquakes with $K > 13$. At the same time, there were five jolts on its territory with an energy of K=13 ($M \geqslant 5$), localized in the central part of Northern Iran. Two of them were recorded in the same region in which an earthquake with similar intensity occurred in 1972, and the rest of the focal points occurred in more northern areas of Iran--in Central Khorasan. According to information from Teheran Radio, the earthquake on 29 January was felt in some villages of Western Khorasan (Iran) with an intensity of 5 points (on the MSK-64 scale). These jolts were not noticed on the territory of the Turkmen SSR.

The epicenters of three jolts with K=12 (Table 2) were located within the limits of the focal zones of earthquakes with K=13.

One earthquake with K=12 occurred on 20 August at 01:27 in Western Turkmeniya. Its focus lies in the southwestern spurs of the Karagez Range, where there are no population centers. According to the accounts of shepherds, during the earthquake quite a strong vibration of the ground was felt; metal dishes in the hut rattled and water splashed out of the pail; guard dogs and livestock showed alarm. The earthquake was felt with an intensity of 4-5 points. In the villages of Beki-Bent and Danata, 40-50 kilometers away from the focus to the northwest and the north, the inhabitants did not notice the temblors.

Just as in 1972, a dense concentration of focal points is observed in the position of the epicenters in Northern Iran and on Turkmenian territory and southeast of Kara-Kala. It is impossible to establish a clear-cut boundary between these areas. It is possible that this is the result of the small number of seismological stations monitoring the tectonic activity of the region. As new stations are opened and factual material is accumulated, it will probably be possible to mark a certain boundary between these areas or to ascertain the conformances to principle of the easing of stresses in each of them. The area noted is bounded by the coordinates 37-38.5° N lat., and 55.5-57.5° E long.

Table 2. Strongest Earthquakes in Kopet Dag

(1) Дата	Момент возникновения, час, мин, сек (2)	Координаты эпицентра (3)		Глубина очага, км (4)	K	M	№ района (5)	Примечание (6)
		φ°N	λ°E					
19.I	05 49 36	36,55	57,20	42	12		7	Юго-западнее Боджнурда (Иран), 4 балла (7)
29.I	13 24 55	37,10	55,80	40	13		7	Западный Хорасан (Иран), 5 баллов (8)
17.V	16 11 35	36,70	57,60	38	13		7	
22.V	00 50 12	35,30	57,10	45	13		7	
2.VIII	19 56 25	37,40	56,60	30	13	4,9	7	Северный Иран, 6 баллов (9)
	20 28 56	37,30	56,60	30	13	4,6	7	То же (10)
4.VIII	18 12 05	37,30	56,50	35	12		7	"
20.VIII	01 27 56	38,70	55,10	22	12		3	Западная Туркмения, 4–5 баллов (11)
17.IX	04 06 03	36,50	51,10	38	12	4,8	7	Южное побережье Каспийского моря (12)

Key:
1. Date
2. Moment of occurrence, hrs, mins, secs.
3. Coordinates of epicenter
4. Depth of focus, in km
5. Number of region
6. Comments
7. Southwestern Bodzhnurda (Iran), 4 points
8. Western Khorasan (Iran), 5 points
9. Northern Iran, 6 points
10. Same
11. Western Turkmeniya, 4–5 points
12. Southern coastal region of Caspian Sea

Southeast from Krasnovodsk, in the depths of Iran, a strip of epicenters is also traced, the occurrence of which is apparently confined to a deep fault. Single epicenters of strong earthquakes ($K \geqslant 10$) were localized in the region of Nebit-Dag, and weaker ones--Kizyl-Arvat, Kizyl-Atrek, Ashkhabad. Around the latter, as well as near the Vannovskaya station, a whole series of weak shocks were recorded with $\bar{S}-\bar{P} \leqslant 3$ seconds and K=5–8. It should be noted that the region of the Krasnovodsk plateau and the eastern part of the Caspian Sea proved to be less active in 1973 than in 1972.

The general level of seismic activity throughout the region was much higher than last year's because of strong earthquakes with K=13, of which there were five in 1973 and only one in 1972. Some 65 earthquakes of other energy classes (K=10–13) occurred in the period studied, while in 1972 there were 75 of them.

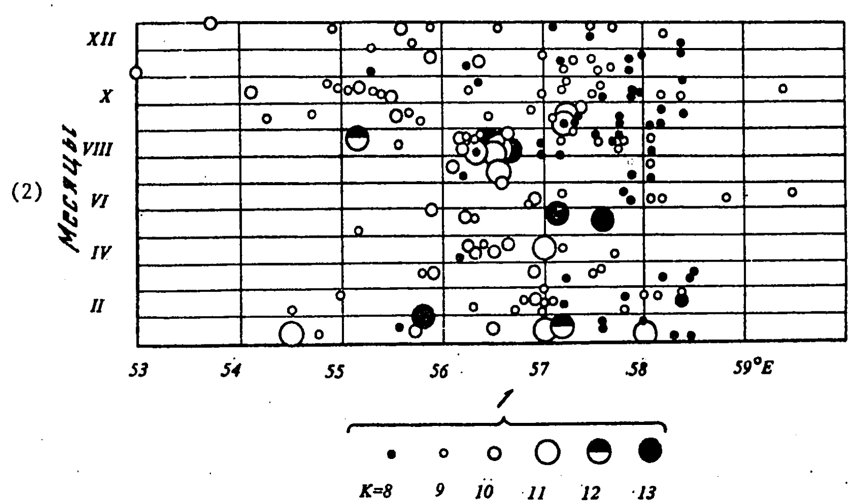

Figure 2. Time Distribution of Earthquakes in Kopet Dag

1--energy of earthquakes; 2--months

A brief analysis of the seismicity of the region, made according to the location of the focal points on the map of epicenters (see Fig. L), although it indicates certain conformances to principle of the concentration of the separation of earthquakes with respect to individual regions in the zone, does not afford us the possibility of seeing the temporal course of events and tracing the process of accumulation and easing of tectonic stresses throughout the zone.

If, however, we examine the maps of the epicenters in conjunction with the diagram of the distribution of earthquakes in time (Fig. 2), a graphically expressed picture is created of the sequence of seismic events.

As can be seen from the diagram, a lessening of stresses in the first approximateion occurred quite unevenly: in the central section of the zone, at the boundary of the meridians of 56-58°E lon, it was more intensively marked. After beginning in the early days of January beyond the limits of the area noted, with a strong earthquake (K=11) in the Nebit-Dag region, where temblors with a magnitude of 4 points were felt, on the next day, on 7 January, the central section of the Kuchan-Meshkhedsk fault "went into operation," and an earthquake of similar intensity occurred there near the Iranian city of Kuchan.

A week later, on 14 January, similar phenomena were observed southwest of Kuchan, accompanied by a series of less intensive repeated shocks. Five days later, on 19 January, a further easing of the stress occurred here, in the form of a stronger earthquake with K=12. According to an Iranian Radio report, the earthquake frightened the population, and was felt with an intensity of 4 points.

At the end of the month, on 29 January, the process of easing included the region lying a total of 100 kilometers northeast of the preceding one: here an earthquake occurred with K=13, which was felt, according to the same source, with a magnitude of 5 points. We do not have detailed information on the further course of the process in the focal zone. Still, though, it may be mentioned that, in addition to the separate weak aftershocks with an energy of K=8-9, no jolts even with K=10 were noted here.

The relative lull in the next three months may also be noticed on the diagram. This is indicated by the fact that there were only two jolts that with respect to the power of the energy released did not exceed K=11, as well as by several weaker earthquakes.

In the middle of May the level of seismic activity rose to the south of Central Khorasan. On 17 May an earthquake occurred here with K=13, and on 22 May the jolt was repeated.

It is possible that these earthquakes served as the cause of further tectonic shifts in the western longitudinal direction, where, during the next week, two more earthquakes with K=10 were recorded.

The June-July period proved to be very quiet: only one earthquake with K=11 occurred west of the Iranian city of Bodzhnurd, and a few underground jolts with less intensity were felt. One of them had a focus directly in Turkmeniya, south of Kara-Kala.

In August the activity of the Bodzhnurd region (Northern Iran) rose sharply. In the epicentral zone of weak earthquakes that had occurred there in June-July, on 2 August in 30 minutes there were two strong jolts with M=4.9 and 4.6. The first of them, according to reports from Iranian newspapers, were accompanied by a rumble and caused small cracks in village buildings with local construction (6 points). The inhabitants hesitated to go back to their houses for several days because of the cluster of aftershocks, of which the jolt on 4 August reached K=12, and on 8 August--K=11.

On 20 August there was quite a strong earthquake (K=12) in Western Turkmeniya --in the southwestern section of the Karagez Range (see above).

If one compares the process of easing of stresses in January in the direction from Nebit-Dag to the regions of Kuchan and in August, which were in the reverse direction, an interesting feature is discovered: the focal points of the earthquakes on 6 January (Nebit-Dag), 7 January (Kuchan), 2 August (Bodzhnurd) and 20 August (Karagez) were located in the same zone of faults, intersecting Northern Iran and Western Turkmeniya, which has a northwest strike and is characterized by intensive movements. In this case the removal of the elastic stresses in one part of the fault causes a redistribution of the process of their accumulation in the peripheral sections of the highly active belt of tectonic activation, which also are rapidly relieved by earthquakes.

The revealing of a temporal conformance to principle, frequency and energy level of these tremors will be possible, as factual data accumulate over longer periods.

A further analysis of the sequence of earthquakes makes it possible to note a gradual dying down of seismic activity by the end of the year, accompanied by a small dispersal of events throughout the entire expanse of the zone. After two earthquakes with K=11, which occurred in the first half of September on Turkmenian territory with the limits of the southeastern part of the Kara-Kala region, where a small, but very compact group of shocks was noted, on 20 September an earthquake with K=11 occurred again in the mountain structure of the Karagez Range. Next day there was an earthquake with K=10 in the southwest part of the zone, in the region of the boundary of the USSR and Iran, near Kizyl-Atrek. A series of weaker focal points extended in a chain along the entire zone--from the Caspian Sea to the Ashkhabad meridian.

A similar distribution of focal points was also observed in the last quarter of the year, in the course of which one earthquake with K=11 occurred in the Caspian lowlands, between Krasnovodsk and Nebit-Dag, and about 50 earthquakes with an energy level of K=10. Among them was a perceptible earthquake which occurred in the villages of Vannovskoye, Chuli and Firyuza with a magnitude of 3-4 points. Its focus was located at a shallow depth, about 10 kilometers, which was estimated according to macroseismic data. Its energy class was 9.

A survey of the seismic activity of Kopet Dag shows that the development of the seismic process in 1973 should be regarded as a relatively quiescent background. Despite the series of earthquakes that occurred in Northern Iran even with an energy of K=13, throughout the Kopet Dag zone the process of accumulation of elastic stresses was predominant. The absence of strong earthquakes on Turkmenian territory also attests to this.

Catalog of Earthquakes in Kopet Dag in 1973

Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	Класс точности	K	№ района
		φ°N	λ°E				
1	2	3	4	5	6	7	10

Key:

1. Date
2. Moment of origin, hrs, mins, secs
3. Coordinates of epicenter: φ °N
4. Coordinates of epicenter: λ °E
5. Focal depth, in km
6. Accuracy class
7. K
8. Number of region

January

5	07 49 39	37,9	57,7	(25)		7	6
6	22 45 07	39,4	54,5	(28)		11	3
7	09 50 09	37,2	58,0	(23)	Б	11	7
	10 23 26	37,3	58,5	(30)		8	6
	20 36 16	37,3	58,3	(30)		8	6
11	11 23 17	37,2	54,8	(40)		9	3
13	18 33 20	37,8	58,4	(25)		7	6
14	20 29 21	36,5	56,8	(25)	А	11	7
16	08 02 34	37,3	55,7	(30)		10	7
17	22 17 20	37,3	56,5	(30)	Б	10	7
18	11 01 59	37,9	57,7	(22)		7	6
19	05 49 36	36,6	57,2	(42)	Б	12	7
	09 39 02	38,0	57,6	(28)		8	6
23	00 21 36	37,7	58,2	(18)		5	6
25	11 02 06	37,9	57,6	(25)		8	6
	18 54 45	37,7	56,1	(30)		9	7
29	10 32 50	37,9	57,6	(20)		7	6
	10 43 18	37,6	58,0	(25)		8	6
	13 24 55	37,1	55,8	(40)		13	7
30	08 54 21	37,4	58,0	(22)		7	6
31	11 52 09	38,0	58,1	(10)		8	6

February

2	01 49 10	37,5	54,6	(40)		9	3
3	00 48 59	38,7	56,7	(35)		9	6
4	11 08 45	37,9	56,9	(35)		9	6
6	19 43 23	37,9	57,8	(20)		6	6
9	06 16 29	38,1	57,8	(35)		9	6
	09 49 25	36,8	56,3	(35)		9	7
10	16 58 25	38,0	58,1	(15)		5	6
11	13 34 21	37,7	58,4	(20)		6	6
12	08 35 41	37,5	58,1	(25)		7	6
	16 58 37	37,7	57,2	(30)		8	6
	17 16 03	37,5	58,2	(25)		7	6
	17 51 54	37,4	58,1	(25)		7	6

1	2	3	4	5	6	7	
	19 51 52	37,5	58,4	(27)		8	
14	00 08 54	37,2	58,4	(40)		10	6
16	10 38 54	37,8	57,7	(25)		7	6
	10 54 51	37,7	57,8	(25)		7	6
	11 16 37	37,9	57,7	(25)		7	6
	13 43 27	38,4	57,0	(35)		9	6
19	07 35 26	38,1	57,6	(27)		7	6
	07 39 27	38,1	58,5	(28)		7	5
	19 59 17	38,3	57,1	(35)		9	6
	20 26 23	38,3	56,8	(35)		9	6
21	11 21 13	38,1	58,5	(25)		7	5
	17 32 01	38,0	58,1	(13)		5	6
	22 31 46	36,0	57,0	(33)		9	7
23	11 02 46	38,0	58,1	(10)		6	6
	11 18 58	38,2	56,9	(45)	Б	10	6
26	07 43 27	38,3	58,0	(35)		9	5
	09 32 24	38,3	56,9	(40)	Б	11	6
	13 07 36	35,8	55,0	(35)		9	7
	17 58 25	38,3	58,1	(35)	A	9	5
27	08 17 15	38,0	58,1	(18)		6	6
	12 37 43	36,9	58,2	(30)		10	7
	18 03 39	38,0	58,1	(10)		5	6
28	10 01 49	38,4	57,0	(35)		9	6
	11 16 19	37,7	57,8	(30)		8	6
				March			
2	15 33 01	38,0	58,1	(10)		6	6
6	07 00 02	37,9	57,9	(20)		6	6
7	07 42 06	38,0	58,1	(10)		7	6
13	07 44 39	37,7	58,5	(25)		7	6
14	10 36 18	37,7	58,5	(30)		8	6
	23 29 08	37,0	58,5	(33)		8	6
15	12 37 53	38,3	57,2	(28)		8	6
	21 08 16	37,2	58,2	(28)		8	6
16	07 29 17	38,1	58,0	(18)		6	6
18	07 41 16	37,2	56,9	(28)		10	7
20	08 12 12	37,9	57,7	(23)		7	6
	21 52 30	37,5	57,5	(30)		8	6–7
24	00 31 38	38,3	57,3	(35)		9	6
27	19 27 13	35,7	55,8	(35)		9	7
29	05 49 01	38,2	55,9	(33)		10	3
30	07 28 23	38,0	58,1	(20)		6	6
	10 54 17	37,9	57,7	(25)		7	6
				April			
4	12 50 03	37,2	57,7	(35)		9	7
6	12 10 03	38,3	56,2	(25)		8	6
10	10 20 02	37,7	56,5	(30)		10	7
12	15 54 50	37,3	57,0	(37)	A	11	7
13	18 52 31	37,3	57,2	(33)		9	7
14	14 31 36	38,1	56,6	(40)		10	6
21	13 04 58	37,7	56,4	(35)		9	7
24	05 11 57	37,5	56,3	(30)		10	6
28	05 12 01	38,0	56,2	(35)		10	7

1	2	3	4	5	6	7	8
				May			
2	23 39 43	36,5	55,2	(40)		9	7
13	17 20 23	38,0	58,1	(10)		5	6
	20 11 09	37,6	58,2	(20)		7	6
14	08 12 27	38,0	58,1	(15)		7	6
17	16 11 35	35,7	57,6	(38)	Б	13	7
18	10 40 37	38,0	58,1	(15)		7	6
20	03 29 03	37,6	56,3	(35)		9	7
22	00 50 12	35,3	57,1	(45)	Б	13	7
	09 38 52	36,1	56,2	(30)		10	7
24	23 44 54	38,1	58,1	(15)		6	6
25	11 03 09	38,0	57,7	(22)		7	6
27	23 10 31	38,0	58,1	(15)		6	6
28	11 28 16	38,0	58.1	(10)		7	6
29	10 54 47	38,0	58,1	(10)		6	6
31	09 03 56	37,5	55,9	(33)		10–11	7
				June			
1	00 55 31	38,0	58,1	(18)		7	6
4	21 31 23	38,1	56,9	(45)		10	6
5	09 45 45	38,0	58,1	(15)		6	6
8	01 13 34	37,8	58,8	(22)		7	5
	20 55 56	37,7	58,8	(40)		9	6
9	05 27 49	37,2	58,1	(43)		10	7
	05 30 29	37,7	58,2	(40)		9	6
10	19 40 48	37,2	56,9	(50)		10–11	7
13	18 51 01	37,8	57,9	(30)		8	6
18	07 33 40	37,4	57,2	(45)		10	7
20	11 09 02	37,8	57,8	(28)		8	6
21	10 00 57	37,7	57,9	(25)		7	6
	12 09 32	36,5	59,5	(40)		10	6
27	11 00 33	38,0	58,1	(20)		7	6
29	06 37 04	37,5	56,6	(30)		10	7
	17 24 32	38,0	58,1	(18)		5	6
				July			
4	12 05 52	37,7	58,1	(25)		8	6
8	06 13 27	37,6	56,6	(35)		10,5	7
11	07 42 27	37,8	58,1	(22)		7	6
12	10 33 24	37,8	57,9	(22)		8	6
14	21 57 04	37,9	58,4	(15)		6	6
15	08 25 35	37,9	58,4	(10)		6	6
	14 33 06	36,8	56,2	(35)		9	7
	15 25 37	37,9	58,4	(10)		7	6
19	12 07 37	38,2	56,1	(28)		10	7
30	02 36 34	36,6	58,1	(35)		10	7
				August			
2	09 45 59	38,0	58,1	(10)		5	6
	19 56 26	37,4	56,6	30(33)	A	13 $M=4,9$	7
	20 28 55	37,3	56,6	30(37)		12–13	7

1	2	3	4	5	6	7	8
						M=4,6	
	23 30 32	37,5	56,5	(35)	Б	9	7
4	00 20 00	37,5	58,1	(33)		8	6
	10 44 17	37,3	56,6	(30)		8	7
	13 19 15	37,0	57,0	(28)		8	7
	15 42 09	37,4	57,2	(35)		8	7
	18 12 05	37,3	56,5	(35)	Б	12	7
	19 02 12	37,5	56,5	(33)		8	7
	23 09 20	37,5	56,5	(35)		9	7
	23 31 27	37,5	56,5	(35)		9	7
6	13 03 33	38,0	58,1	(12)		8	6
	21 31 37	35,8	57,8	(50)		10	7
7	05 17 40	37,2	56,6	(52)	Б	10	7
	07 31 06	38,0	58,1	(25)		7	6
8	08 17 33	37,5	56,6	(33)		9	7
	21 58 28	37,1	56,4	(40)	Б	11	7
9	02 31 20	37,4	57,8	(28)		9	6
	06 05 36	37,4	56,7	(30)		9	7
	21 10 11	37,2	56,6	(28)		8	7
11	06 49 01	38,3	56,2	(38)	Б	10	6
	09 35 07	38,2	55,6	(40)		9	3
13	10 35 31	37,2	56,6	(25)		8	7
15	11 00 28	37,8	57,7	(23)		8	6
18	12 43 19	37,0	57,0	(22)		8	7
	23 35 00	36,8	57,2	(35)		9	7
19	01 47 38	38,1	58,6	(16)		6	5
20	01 27 56	38,7	55,1	(22)	Б	12	3
21	07 43 13	37,8	57,6	(40)		9	6
22	10 59 33	38,0	57,7	(25)		7	6
27	07 17 39	37,3	58,1	(40)		9	6
	17 13 02	36,8	56,3	(38)		9	7
28	17 45 01	37,6	56,2	(40)		10	7
29	10 09 45	37,6	57,6	(33)		8	6
	10 49 23	37,5	57,8	(30)		8	6
31	08 15 12	38,3	57,3	(38)		10	6
			September				
2	05 45 37	38,0	58,1	(10)		4	6
3	04 10 13	37,4	57,8	(28)		8	6
4	09 30 53	37,6	58,2	(28)		8	6
	11 17 36	37,9	57,8	(25)		7	6
	12 38 36	37,2	57,8	(30)		8	7
7	11 32 33	36,2	57,3	(33)		8	7
8	14 28 41	38,1	57,2	(48)	Б	11	6
10	20 57 54	37,6	38,1	(28)		8	6
12	02 48 13	38,15	57,20	(50)	Б	11	6
	12 27 43	37,8	55,8	(30)		10	7
13	02 57 19	38,2	57,2	(30)		8	6
15	20 28 41	37,1	54,3	(40)		10	3
17	04 06 03	36,5	51,1	38 (45)		12	7
						M=4,8	
	10 35 36	38,0	58,1	(15)		4	6
	14 29 29	38,1	57,1	(40)		10	6
18	00 05 26	38,0	58,1	(10)		4	6
	09 39 47	37,5	58,0	(22)		7	6

1	2	3	4	5	6	7	8
19	00 21 46	37,4	57,3	(30)		8	7
20	11 00 34	37,8	58,2	(18)		6	6
	13 29 43	38,7	55,6	(33)	Б	11	6
21	07 30 30	37,4	54,7	(48)		10	3
	20 03 19	36,5	56,5	(33)		9	7
22	10 28 33	37,9	55,7	(38)		9	3
25	10 24 12	37,6	58,4	(30)		8	6
27	10 48 18	37,8	58,2	(25)		8	6
28	07 18 24	37,7	57,8	(22)		7	6
	08 16 23	38,0	56,9	(30)		9	6
30	02 47 02	37,4	57,4	(30)	Б	10	7
	07 32 29	37,8	58,1	(23)		7	6
			October				
4	19 42 56	37,3	56,5	(45)		10	7
5	01 04 41	37,8	56,4	(40)		9	7
7	11 30 09	38,0	58,1	(10)		6	6
8	02 01 45	37,6	58,2	(35)		9	6
	02 04 57	37,6	58,4	(30)		10	6
	13 08 53	37,3	56,3	(40)		9	7
12	07 41 37	39,1	57,5	(35)	Б	10	5
	22 59 46	39,8	54,1	(27)		11	3
15	16 18 09	37,4	57,2	(30)		9	7
	20 42 31	37,8	56,3	(30)		9	7
16	07 28 12	37,7	57,9	(40)		8	6
	11 28 17	38,0	57,6	(25)		7	6
	11 32 03	38,0	57,6	(30)		8	6
	22 29 36	35,5	59,4	(40)		10	7
18	12 25 45	38,0	58,1	(15)		4	6
	18 03 41	38,0	57,0	(30)		9	6
19	00 19 45	37,3	56,1	(33)	А	9–10	7
	04 04 07	37,3	56,0	(33)	Б	9–10	7
	15 28 03	38,3	57,3	(33)		10	6
20	15 20 35	37,9	58,0	(10)		9	6
	19 22 50	39,2	54,9	(40)		9	3
22	02 19 16	38,0	56,4	(33)		8	6
	04 02 59	38,0	58,1	(15)		4	6
23	07 50 25	37,7	57,9	(35)		8	6
	11 39 49	37,6	57,2	(35)	Б	10	7
26	09 00 09	38,0	56,2	(50)		10–11	7
27	09 54 26	38,0	58,1	(18)		7	6
	10 41 16	38,0	58,1	(15)		5	6
29	09 36 44	37,6	58,4	(35)		8	6
			November				
1	17 51 27	38,0	56,3	(30)		8	6–7
3	23 54 56	36,1	52,8	(35)		10	7
4	12 17 19	38,0	58,1	(12)		4	6
5	14 31 33	37,1	57,8	(33)		8	7
	15 55 20	37,8	58,2	(20)		6	6
6	22 06 57	38,0	57,6	(28)		8	6
11	12 27 53	37,8	57,9	(30)		8	6
12	19 22 59	37,8	57,7	(40)		9	6
13	10 34 32	38,0	58,1	(12)		6	6
	13 14 22	37,4	57,2	(40)		9	7
14	09 26 52	36,8	56,3	(33)		8	7

1	2	3	4	5	6	7	8
23	08 00 55	37,8	56,4	(35)	Б	10	7
	08 23 34	38,0	58,1	(18)		5	6
	10 57 43	37,8	57,2	(38)		9	6
24	14 54 39	36,8	57,3	(40)		9	7
26	07 52 12	37,2	57,5	(38)		9	7
27	13 25 51	37,0	55,9	(35)		10	7
	20 34 46	37,9	58,4	(10)		7	6
28	07 40 35	37,9	57,9	(30)		8	6
29	08 05 55	37,7	58,0	(30)		8	6
	14 07 22	38,3	57,0	(40)		9	6
30	09 05 26	38,3	56,3	(40)		9	6
				December			
1	22 26 05	38,0	58,1	(10)		5	6
	23 27 43	38,0	58,1	(12)		6	6
	23 49 30	38,0	58,1	(18)		7	6
14	07 28 35	37,6	58,4	(30)		8	6
15	06 07 45	37,7	58,4	(30)		8	6
17	10 53 35	37,7	57,5	(30)		8	6
19	11 01 31	38,0	58,1	(18)		6	6
20	19 22 50	39,2	54,9	(40)	Б	9	3
24	19 15 57	37,6	55,9	(45)	Б	11	7
26	08 09 18	38,1	56,6	(40)		9	6
	08 27 11	38,2	55,9	(35)		9	3
	08 38 52	37,9	58,0	(20)		6	6
	09 42 00	37,6	58,2	(35)		9	6
27	07 29 36	37,9	58,0	(25)		7	6
28	17 30 32	38,1	57,1	(25)		8	6
29	05 29 28	35,6	57,7	(40)		9	7
30	00 21 23	37,3	57,5	(33)		9	7
31	07 39 51	37,8	53,7	(32)		10	1
	18 03 57	38,0	58,1	(18)		5	6

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EARTHQUAKES IN CENTRAL ASIA AND KAZAKHSTAN

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In 1973 earthquakes in Central Asia were recorded by 54 permanent seismological stations, i.e., by 4 more than in 1972. The Institute of Geology of the Kirgiz SSR Academy of Sciences opened three new temporary stations: Sufi-Kurgan, Kirovka and Manas--the Institute of Earthquakeproof Construction and Seismology of the Tadzhik SSR Academy of Sciences--a temporary station at Ragun, and after a break of a year again put into operation temporary stations at Ak-Kuyli and Bogizagon. The Kalaydasht station was not in operation in 1973. Data from temporary field stations located in Kirgiziya, in Dushanbinsko-Garmskiy Rayon at the Tashkent Geodynamic Testing Ground and more distant permanent stations (Kizyl-Arvat, Sverdlovsk, Semipalatinsk) were also drawn in, including that from foreign ones (Kvetta, Kabul, Varsak, Mangla, Lahor).

The methodology for determining the coordinates of the hypocenters of the earthquakes remained similar to that of the preceding years.

Special Characteristics of Seismicity in Central Asia

In 1973 on the territory of Central Asia, the epicentral location was determined for 1,527 earthquakes with $K \geqslant 9$, and of them, 785 with focal points in the earth's crust and 742 deep Pamir-Hindukushi earthquakes.

The earthquakes were distributed in the following manner with respect to the energy classes:

K	9	10	11	12	13	14
Number of earthquakes:						
with focal points in earth's crust	451	232	72	24	5	1
deep Pamir-Hindushki	308	305	88	30	10	1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000100100027-0

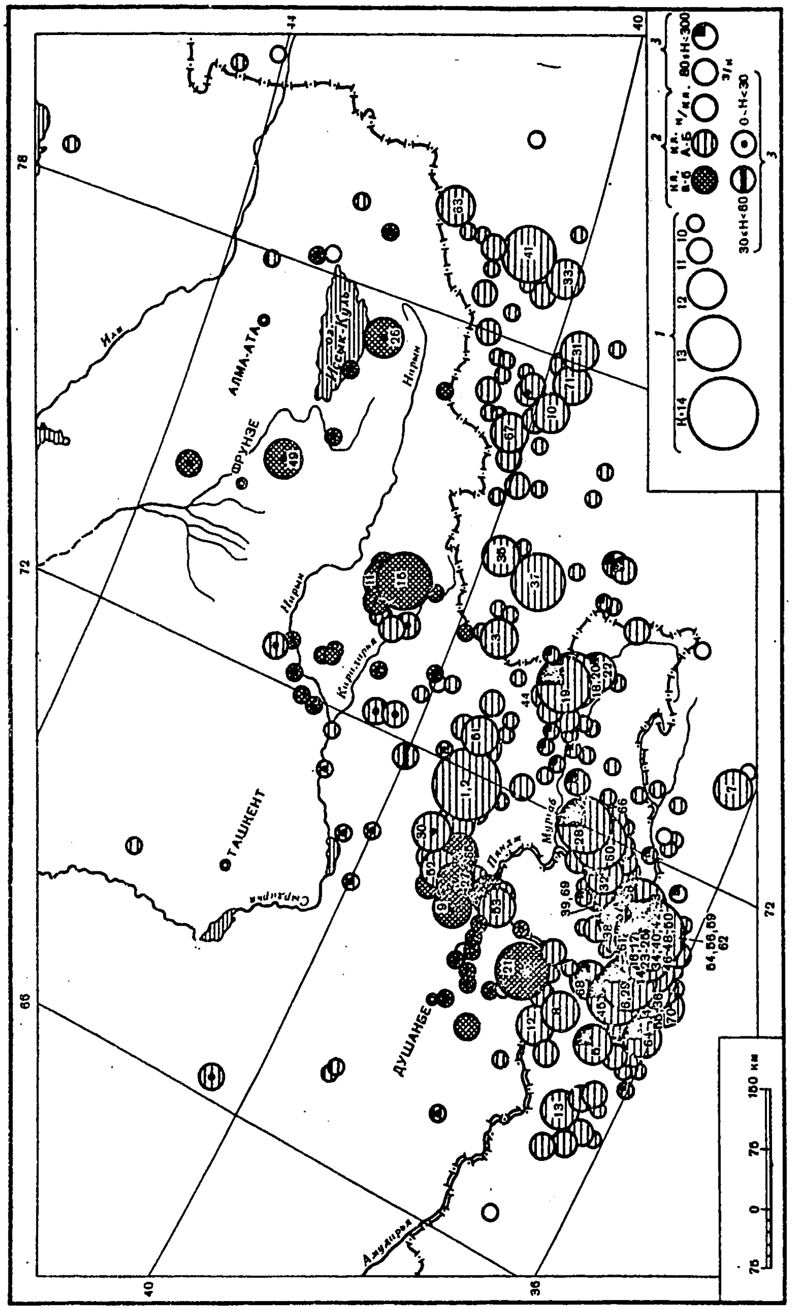

Figure 1. Map of the Epicenters of Earthquakes in Central Asia With K $\geqslant$ 10

1--energy of earthquake; 2--accuracy of determining epicenter; 3--depth of focus, in km

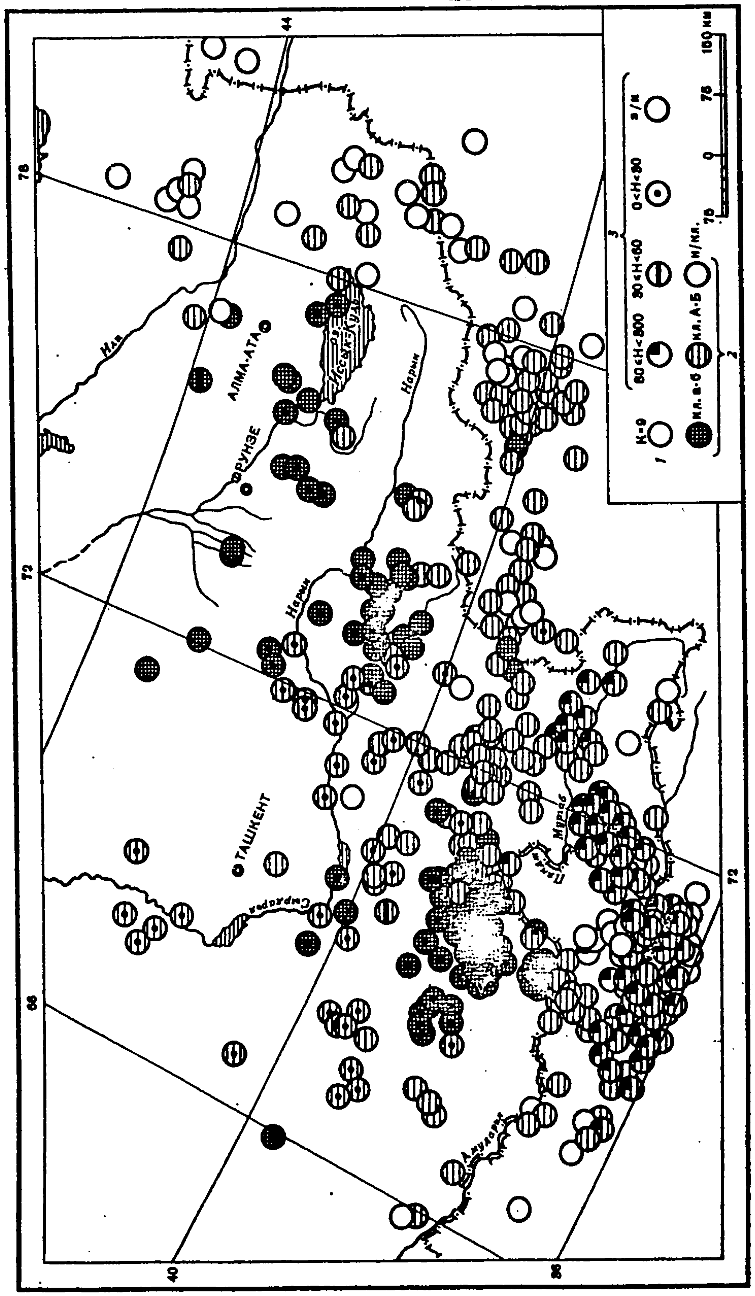

Figure 2. Map of the Epicenters of Earthquakes in Central Asia With K=9

For designations see Figure 1.

The number of earthquakes in 1973 is considerably less than in 1971 and 1972. This is mainly related to the smaller number of crust earthquakes with K==9-10. The number of earthquakes with $K \geqslant 12$ remained at the 1972 level. In 1973, however, only two earthquakes with K=14 were recorded, while in 1972 seven earthquakes with K=14 and three with K=15 were recorded.

Figures 1 and 2 show maps of the epicenters of earthquakes with $K \geqslant 10$ and K=9 respectively.

Attention is drawn by the relatively high accuracy of determining the coordinates of the epicenters of earthquakes in the Dushanbinsko-Garmsk region, in the Fergana valley and in the region of Lake Issyk-Kul', which is connected with the more dense network of stations in these regions and the presence of local travel time curves. On the rest of the territory, as compared with the preceding years, the accuracy of determining the coordinates of the epicenters also increased, which was caused by the more efficient work of the network of seismological stations.

Table 1 shows the distribution of earthquakes for the regions [1].

An analysis of the seismicity was made for four major tectonically quasi-uniform seismoactive zones: Northern, Central, Southern Tian Shan and Pamir-Hindukush, which combine smaller regions, into which the territory of Central Asia was formerly broken up [1] (Fig. 3). The latter region was regarded separately with respect to crustal and subcrustal earthquakes.

Included in zone I, conditionally called Northern Tian Shan, are the regions: Northern Tian Shan proper (No 7) and the Dzhungarskiy Alatau system (No 13), adjoining it on the north and west, the sands of Sary-Ishikotrau (No 14), Taukum (No 15), Muyunkum (No 18), the Iliyskiye Mountains (No 16), Karatau Range (No 19) and the Betpak-Dala Desert (No 17).

In zone II, i.e., Central Tian Shan, are: Central Tian Shan (No 6), the Fergana Valley (No 8), the Chatkal'skiyye Range system (No 9), the region near Tashkent (No 10) and the regions, adjacent to them of western Uzbekistan and the Kyzl Kum sands (No 20), Kara Kum (No 22) and the Nuratau Range (No 21).

In zone III--Southern Tian Shan: Southern Tian Shan (No 5), the Tadzhik depression (No 4) and the Baysuntau Mountains (No 23).

In zone IV--the Pamiro-Hindukush regions: Hindukush (No 1), Southern Pamir (No 2), Northern Pamir (No 3), Western Kun'lun' (No 11) and the Takla-Makan Desert (No 12). As has already been mentioned, this zone we examined twice: separately for the crustal and subcrustal focal points of the earthquakes.

Table 1. Distribution of Earthquakes by Regions

№ района (1)	Число землетрясений (2)		№ района (1)	Число землетрясений (2)	
	всех (3)	с $K \geq 12$		всех (3)	с $K \geq 12$
1	98/530*	3/30*	11	32/5*	3
2	128/205*	4/11*	12	18	3
3	212/2*	8	13	13	–
4	17	–	15	3	–
5	136	5	16	1	–
6	36	4	18	6	–
7	21	–	20	1	–
8	41	–	21	1	–
9	10	–	22	4	–
10	5	–	23	1	–

(4)* Числитель – число коровых, знаменатель – глубоких землетрясений.

Key:

1. Number of region
2. Number of earthquakes
3. Total
4. Numerator--number of crustal, denominator--of deep earthquakes

In accordance with this division, the earthquakes in 1973 are distributed by regions and classes in the following way:

K	9	10	11	12	13	14
Number of zone:						
1	31	8	1	1	–	–
2	70	22	7	2	1	–
3	96	38	15	5	–	–
4	252	164	49	16	4	1
Deep earthquakes	308	305	88	30	10	1

Figure 4 shows the graphs that illustrate the change in the total seismic energy by years during the period from 1962 to 1973 by individual regions and by all the regions for crustal earthquakes. In examining the graph the cyclical nature in release of energy with a two-year period can be very clearly seen. The exception is only in 1970 and 1971, when a reduction in the level of energy released was observed. After that this cyclical nature is restored. The amplitude of the fluctuation is in the order of approximately one, and changes within a range of the 14-15th energy classes.

The largest proportion of all the seismic energy is usually released in Pamir, which is evidenced by the graph for this region, which repeats that described above with a very small shift downward along the vertical axis. Some difference is observed only in 1970, when a large amount of the energy was released not in Pamir, but in Central Tian Shan.

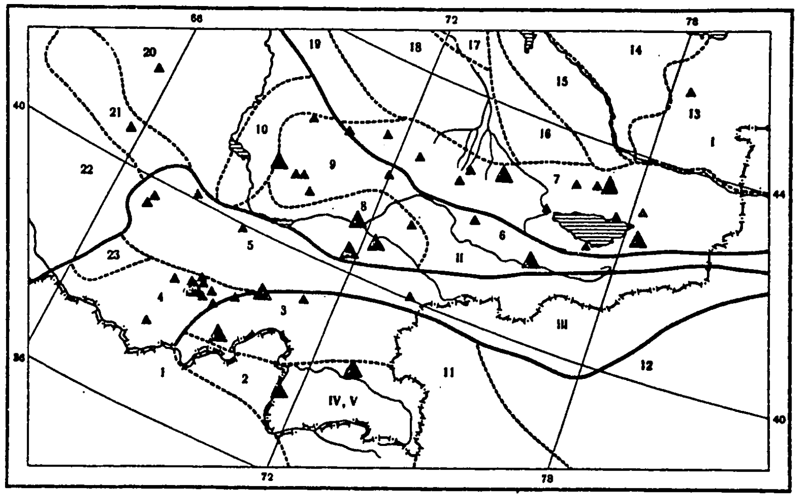

Figure 3. Map of the Seismic Regions of Central Asia

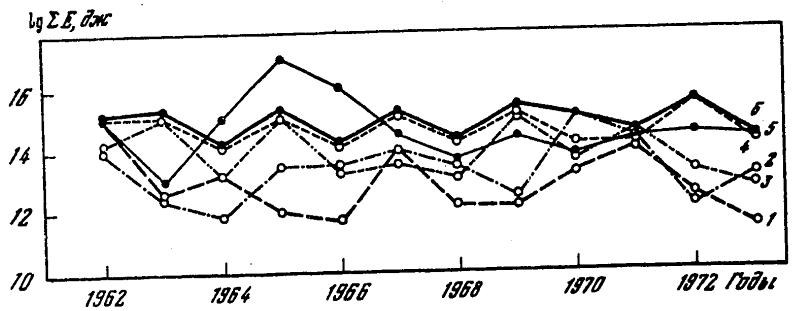

Figure 4. Graphs of the Total Seismic Energy

1--Northern Tian-Shan; 2--Central Tian-Shan; 3--Southern Tian-Shan; 4--Pamiro-Hindukush (earth's crust); 5--Pamiro-Hindukush (subcrustal); 6--total curve for crustal earthquakes

Southern Tian Shan is in general in second place with respect to seismic energy released. In 1971 only did it move into first place. Here too the cyclical nature mentioned above is mainly retained. In 1973 in this region, just as in Pamir, the drop in the level of seismic energy released was noticeable. The maximums on the graph for this region are similar to the first two, and the minimums are lower by 1-1.5 orders of magnitude.

The graph for Central Tian Shan lies considerably lower. Here there is no longer the cyclical nature that we observed. The maximums of seismic energy released are noted in 1962, 1967 and 1970.

Table 2. Macroseismic Data on the Earthquake on 3 January

No, in order	Location	Δ, km	No, in order	Location	Δ, km
	4-5 points			3 points	
1	Russkoye Selo	160	11	Yaypan	170
2	Leninskoye	215	12	Tuleyken	180
3	Kara-Kul'dzha	230	13	Kara-su	200
	4 points			2-3 points	
4	Karavan	140	14	Tashkent	325
5	Fergana	145			
6	Osh	180		Not noted	
7	Andizhan	195			
			15	Dzhovid	70
	3-4 points		16	Vanch	80
8	Kuygan-Yar	200	17	Dashton	95
9	Sernyy rudnik	220	18	Kulyab	210
10	Bekabad	225	19	Leninabad	225
			20	Mayli-say	250

The graph for Northern Tian Shan also makes no note of the periodicity. The maximums were observed in 1962, 1967, 1971, and in the rest of the years there was a relatively even variation.

In Central and Northern Tian Shan the interval between the maximums for the release of seismic energy is 3-5 years, which was apparently caused by the greater consolidation of the substance of the earth's crust in these regions as compared with the Pamir-Alay region [2].

It should be noted that, as usual, the seismicity of the zones enumerated is reduced to the north and west, i.e., in the direction of the Central Kazakhstan shield and the Turanskiy platform.

The graph of the seismic energy released in the zone of the deep Pamir-Hindukush earthquakes may be subdivided into two sections, which differ sharply from each other. In the first of them (1962-1967) a considerable maximum is noted in 1965. In the other years the graph repeats in a similar way for all the crustal earthquakes, but is located approximately one order below it.

The highest seismicity due to a crustal earthquake is observed in Pamir (zone IV), where in 1973 the amount of seismic energy released was the greatest as compared with the other regions. It is less, however, than in 1972, by an order of approximately one. The major crustal earthquake in 1973 with K=14 occurred in this zone on the southwestern slopes of the Alay Range on 3 January at 14:31 (No 1). The repeat jolt with K=12 followed a half hour after the main one (No 2).

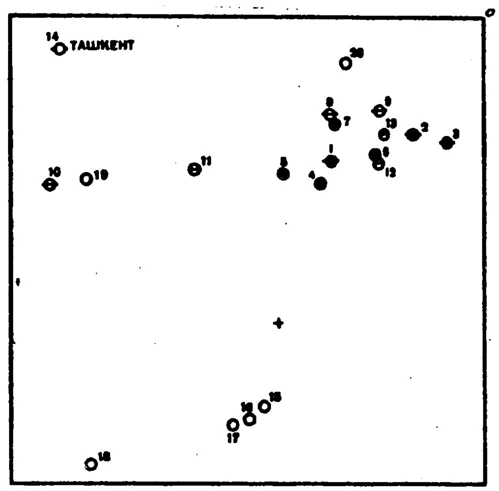

Figure 5. Macroseismic Data on the Earthquake on 3 January. Drawn Up by V. K. Iodko and A. F. Krasnova

For conventional designations see Figure 6.

The first earthquake with the greatest intensity of 4-5 points was felt at population centers in Russkoye Selo, Leninskoye and Kara-Kul'dzha, 150-215 kilometers away from the epicentral area (Fig. 5).

Table 2 shows the list of locations at which this earthquake was felt, with an indication of the epicentral distance and intensity.

A second earthquake (aftershock) was felt at Andizhan, 190 kilometers away, with an intensity of 2 points. By the end of 1973 one more earthquake with K=12 (No 51) had been recorded here, and about 20 weaker repeated jolts.

On 2 April at 02:43 (No 21), on the boundary of the Soviet Union and Afghanistan, south of Kulyab, an earthquake occurred with K=13. It was accompanied by a series of aftershocks, some of which were felt with an intensity up to 5 points. The epicentral 6-point zone had an area of about 400 square kilometers. Many buildings within its range were damaged. A description of the consequences of this earthquake is the subject of a separate article in this collection.

The aftershock of this earthquake with K=11 was felt in the village imeni Vose, 40 kilometers away, with an intensity of 3-4 points. Two earthquakes were recorded south of them with K=12 (Nos 6, 12) and two with K=11, which preceded the earthquake on 2 April. The earthquake on 8 February at 01:08 (No 12) was felt in the settlement of Kyaylsu (7 km) and in the Komsomol section (10 km) with an intensity of 3-4 points, at Gissar (17 km), Parkhar (23 km) and imeni Vose (65 km)--3 points, and at Moskovskoye (45 km)--2-3 points.

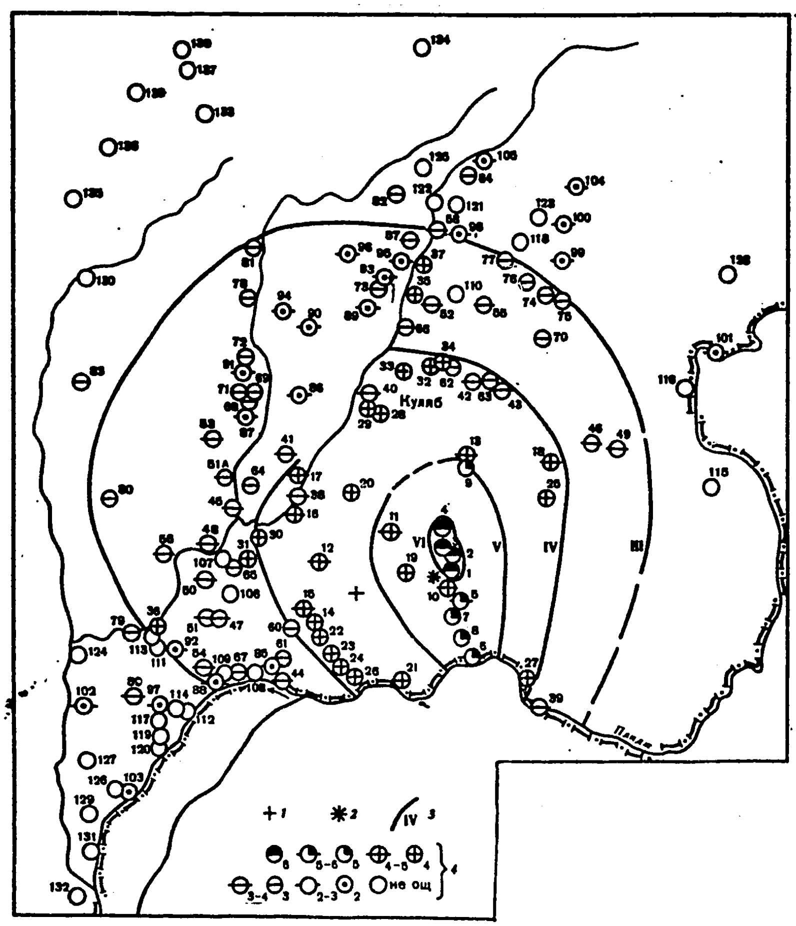

Figure 6. Diagram of the Isoseismal Lines of the Psta-Mazar Earthquake on 8 March. Drawn Up by A. A. Kon'kov and T. Nizamov

1--epicenter according to instrument data; 2--epicenter according to macroseismic data; 3--isoseismal lines; 4--intensity

The first of the earthquakes with K=11, on 12 February at 00:19, with the greatest intensity of 4-5 points, was felt at the village of Dagan (8 km), 4 points--noted at Sary-Chashme (10 km) and Sang-Chien (45 km). The temblors reached 3 points at the population centers of Bagarak (5 km), Zar-Goron (13 km), Kayragach (14 km), Ak-Mazar (15 km), Chagan-miona(17 km), Lilikutal (20 km), Kulyab (25 km), Tu-Tu (35 km).

The second earthquake occurred on 8 March at 18:40, southeast of Kulyab (Fig. 6, Table 3).

Table 3. Macroseismic Data on the Earthquake on 8 March

No, in order	Location	Δ, km	No, in order	Location	Δ, km
	6 points		33	Kulyab	23
1	Psta-Mazar	2	34	Tudakalish	24
2	Odinaboi	3	35	Fayzabad	31
3	Galakhirman	5	36	Karaaryk	33
	5-6 points		37	Ser'yezi-Bolo	35
5	Pravda Kolkhoz Farm	5		3-4 points	
6	Bagarak	11	38	Ibrat	18
	5 points		39	Bakh	20
7	Dzhilga	5	40	Lagmon	22
8	Novyy Bagarak	8	41	Imomali	22
9	Chagan-Poen	13	42	Farm No 1	22
	4-5 points		43	Mumirak	22
			44	Ak-Mazar	22
10	Mishkaron	2	45	Kurbanshent	24
11	Chordara	7	46	Shuroabad	24
12	Kayragach	13	47	Khloppunkt	26
13	Chagan-miena	14	48	Guliston	26
14	Pravda district	15	49	Khodzhagal'ton	26
15	Ak-Mazar	16	50	Dashtiglo	27
16	Sol'zavod No 1	17	51	Kolkhoz imeni Lenin	27
17	Imeni Vose	19	51a	Krupskoy District	27
18	Komsomolabad	19	52	Ziraki	30
	4 points		53	Sel'bur	30
			54	Safedou	30
19	Murgabi	3	55	Tu-Tu	31
20	Zakirabad	13	56	Razvilka-Olimtay	32
21	Dagana	13	57	Pushion-bolo	38
22	Tugul	15	58	Toka-Tepa	39
23	Khoetinav	15	59	Ortaboz	39
24	Chubek I	15		3 points	
25	Devdor	15	60	Moskovskiy	18
26	Chubek II	15	61	Sadvinsovkhoz	20
27	Sarkhialom	16	62	Tebolyay	23
28	Zarbdor	19	63	Tu-To	23
29	Kolkhoz imeni Zhdanov	20	64	Otchanor	23
30	Sol'zavod No 2	21	65	Druzhba Kolkhoz, Gulobad District	23
31	Druzhba Kolkhoz	22			
32	Bagikhabib	23	66	Choktemur	28

Table 3 (cont'd)

No, in order	Location	Δ, km	No, in order	Location	Δ, km
	3 points			Not noted	
67	Sovkhoz imeni Turdyyeva	28	106	Kolkhoz imeni Pravda	24
68	Aral	29	107	Aria-Tugul'dy	24
69	Khul'bek (lower)	29	108	Bashkapa District	24
70	Sharybarbar	30	109	Sayat	27
71	Khul'bek (upper)	30	110	Shar-shar	28
72	Gurdara	33	111	Archa	33
73	Kolkhoz imeni Kirov	33	112	Dzharayly I	33
74	Chashmadushon	34	113	Samanchi	34
75	Langar-Kalon	34	114	Dzharayly II	34
76	Sang-Chien	35	115	Iol	34
77	Kipchak	36	116	Khirmandzhou	36
78	Tanapchi	38	117	Novabad	36
79	Samanchi-poen	38	118	Chukurek	38
80	Olimtay	39	119	Kalaypushtak I	38
81	Sovetskiy	42	120	Kalaypushtak II	38
82	Kuduk	43	121	Kul'	42
83	Kuybul'yen	46	122	Anvarabad	42
84	Khanabad	46	123	Bagtai	42
	2-3 points		124	Matros	43
			125	Ovnova	46
			126	Parkhar II	46
85	First Division of Sadvinsovkhoz	22	127	Shaftolyubog	46
			128	Dashtidzhum	48
86	Kaduchi	25	129	Komsomol District	49
87	Zardolyubag	28	130	Dzhartepe	52
88	Sayat	29	131	Komsomol	52
89	Uchkun	31	132	Kyzylsu	56
90	Chol-Sartis	31	133	Chil'ga	59
91	Taskala	31	134	Khalkayer	59
92	40 Let Tadzhikistan District	32	135	Dangara	60
			136	Gargara	61
93	Pushion-poen	33	137	Duachashma	64
94	Bacha-Mazar	34	138	Daganinomak	65
95	Pushion-miyena	36	139	Kangurt	67
96	Karim-berdy	37			
97	Davlyatabad	38			
98	Dakhana	38			
99	Debaland	39			
100	Sary-Maydon	42			
101	Shagon	42			
102	Kyzyl-Pakhtachi	44			
103	Parkhar I	44			
104	Muminabad	47			
105	Vodazabor Yakshu R.	47			

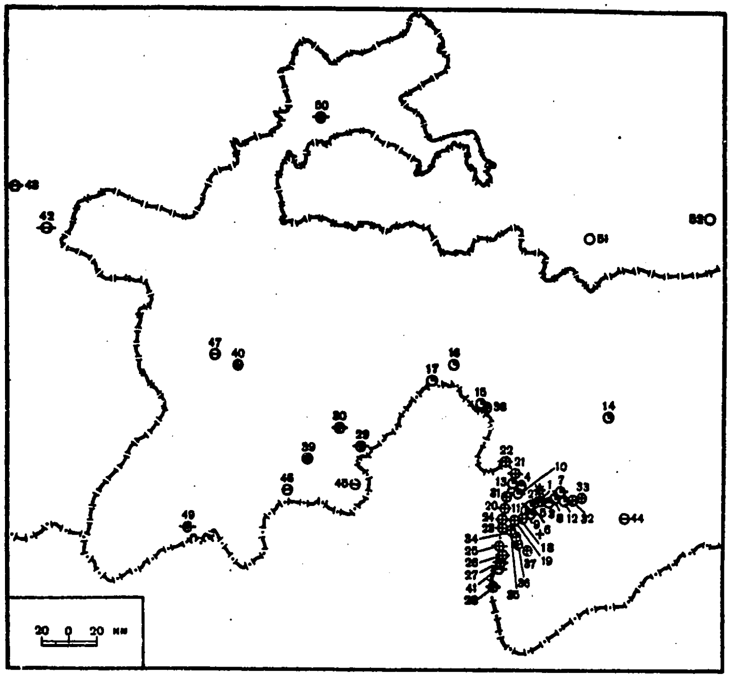

Figure 7. Macroseismic Data on the Earthquake on 12 October. Drawn up by T. A. Kinyapina, Kh. M. Mirzobayev

For Conventional Designations see Figure 6.

Within the limits of the epicentral 6-point zone the inhabitants were awakened from the strong vibrations, and fled from their homes in terror. A rumbling was heard. Objects standing on shelves fell. Most of the "type A" structures sustained first-degree damage, and the others--second degree, and the adobe partitions and old, dilapidated structures--third and fourth degree damage.

Some "type B" buildings also sustained first degree damage. The depth of the focus, determined according to the areas of the isoseismal lines, was 10-12 kilometers. Using the regional values of the coefficients (b=144, ν=3.9, c=3.4) according to N. V. Shevalin's formula, the depth was 9-13 kilometers. A small group of earthquakes, the strongest of which has an energy class of K=12 (No 13), localizes the boundary of this zone with Southern Tian Shan at the extreme southwest.

On 10 June at 16:08, east of the epicenters of the earthquakes on 3 January in the northeastern spurs of the Kun'lunya, another earthquake occurred with K=13 (No 37). It was preceded by an earthquake at 02:15 with K=12 (No 35) north of it. At the end of 1972 there were two class-12 earthquakes here and a series of 10 weaker jolts.

The epicenter of the next earthquake, with K=13, which occurred on 27 June at 13:11 (No 41), was located still further to the east of the epicenter of the earthquake on 10 June, on the territory of China, in the Takla-Makan Desert. South of it, on 17 May at 11:06 an earthquake was recorded with K=12 (No 33) and several weaker jolts. At the beginning of 1972 in this same region a group of earthquakes was registered, the strongest of which had K=14.

Southwest of them, on the southern spurs of the Kokshaal-Tau Range, an even larger group of earthquakes was recorded, four of which have an energy class of K=12 (Nos 10, 31, 67, 71). Two of them (Nos 10, 67) were located in Southern Tian Shan, but they also, apparently, can be included in this group.

On 12 October at 02:54, an earthquake with K=13 was registered (No 60), which occurred in the zone of the Guntsko-Alichurskiy (Southern Pamir) fault (Fig. 7, Table 4). It displayed a magnitude of 7 points in the villages of Mun and Debasta, located in the Gunt River valley, 25-35 km northeast of the city of Khoroga. Due to the uneven distribution of the population centers in the locality, it proved impossible to draw up a map of the isoseismal lines. At the 7-point centers, the earthquake was accompanied by a strong rumble, similar to the sound of an explosion. Sharp vertical tossing vibrations were felt. The people fled from their quarters in fear. The earthquake was accompanied by the roar of landslides and the crumbling of mountain slopes. Transport traffic was brought to a halt. The cloud of dust was dispersed only 30-45 minutes later. As the result of the earthquake, in the villages of Mun and Debasta the walls of one-story apartment houses of the "A" type, made of rubble or rounded stone suffered severe damage from numerous and often random ramified cracks. Some cracks, continuing downward, also cut the foundations of the houses, as a rule made from quarrystone using cement mortar. The cracks in the walls near the window apertures were X-shaped, and in the corner junctures--vertical, with the opening upward as much as 2-3 cm. In the clay roofs of the houses, on top, open cracks appeared, duplicating the direction and number of main supporting ceiling beams.

In wooden houses of the Finnish type the chimneys were destroyed at the top. Inside the quarters, the brick ovens came away from the walls.

The soil conditions in the villages of Mun and Debast are identical, and are represented by coarse gravel, and boulder clay with sandy loam filler, forming a slightly sloping terracelike surface.

At population centers with a 6-point temblor, a strong underground rumble resembling an explosion was also heard. The walls of the dwellings (of type "A") were damaged by frequent diagonal, finely ramified cracks. Under the ceiling beams and in the corner junctures of the walls the cracks went in a vertical direction and feathering cracks went off from them. Cracks running in a horizontal direction were encountered. In the village of Vodzh, detachment of the end wall from the ceiling was noted, with the slope of the wall toward the northwest. General, more intensive damage was observed in the walls of houses with heavy earthen ceilings than of houses with lightweight ceilings.

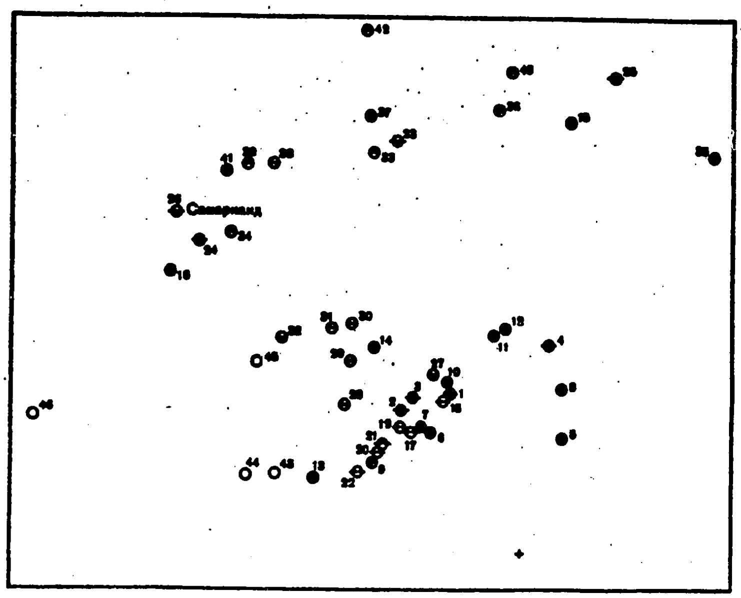

Figure 8. Macroseismic Data on the Earthquake on 17 October. Drawn Up by T. A. Kinyapina, A. A. Kon'kov, A. F. Krasnova

For conventional designations see Fig. 6.

On the boundary of Northern Pamir and Southern Tian Shan, in the Garma region, a large group of earthquakes was recorded, six of which had K=12 (Nos 9, 27, 30, 52, 53, 65). One of them (No 27), which occurred on 21 April at 04:29, was felt at Garma (18 km) with an intensity of 4 points, in Tashkent (283 km)--3 points and in Dushanbe (140 km)--2 points. There is macroseismic information on one more earthquake with K=11 that occurred on 17 July at 08:46. In the village of Sary-Chashma (7 km), the temblors reached 5 points, at Kulyabe (20 km)--4-5 points, and at Shuroabad (16 km) --3-4 points.

Table 4. Macroseismic Data on the Earthquake on 12 October

No, in order	Location	Δ, km	No, in order	Location	Δ, km
	7 points			4 points	
1	Debasta	10	31	Sokhgarv	25
2	Mun	10	32	Chartym	30
	6 points		33	Patkhur	35
			34	Shod	40
3	Vodzh	10	35	Radzhist	40
4	Khuf	15	36	Tavdem	45
	5-6 points		37	Medenshar	45
			38	Lyakhsh	75
5	Dem'yano (Demiona)	10	39	Kulyab	180
6	Sindzh	10	40	Nurek	250
7	Shtam	15		3-4 points	
8	Begzbok	15			
9	Rivak	20	41	Anderob	70
10	Badzhuv	20	42	Urgut	425
	5 points		43	Samarkand	470
				3 points	
11	Tang	20			
12	Vir	20	44	Dzhilandy	70
13	Badzhu-Pasdiv	20	45	Iol	145
14	Savnob	80	46	Moskovskiy	195
15	Vravz	80	47	Dushanbe	270
16	Rokharv	115	48	Tashkent	420
17	Kalay-Khumb	120		2-3 points	
	4-5 points		49	Pyandzh	275
18	Barsen'	20	50	Leninabad	330
19	Suchan	30		Not noted	
20	Yemdzh	30			
21	Pastkhuf	35	51	Darautkurgan	195
22	Rushan	35	52	Sary-Tash	245
23	Khorog	40			
24	Porshnev	40			
25	Pish	55			
26	Nishusp	60			
27	Khas-Khorog	65			
28	Vogz	85			
29	Dashtidzhum	140			
30	Muminabad	160			

Table 5. Macroseismic Data on the Earthquake on 17 October

No, in order	Location	Δ, km	No, in order	Location	Δ, km
	4-5 points			3 points	
1	Shagon	175	27	Muminabad	200
2	Imeni Vose	190	28	Kalininabad	235
3	Kulyab	192	29	Yavan	265
4	Vanch	210	30	Chuyan-Garon	290
	4 points		31	Dushanbe	300
			32	Regar	330
5	Khorog	123	33	Nau	430
6	Bakh	155	34	Pendzhikent	440
7	Bagarak	165	35	Sufikurgan	442
8	Rushan	170	36	Kokand	445
9	Kyzylsu	177	37	Buston	465
10	Dashtidzhum	186	38	Zarbdor	466
11	Kalay-Khumb	220	39	Dzhizak	480
12	Rokharv	223	40	Khalkabad	485
13	Nizhniy Pyandzh	230	41	Gallyaral	490
14	Nurek	255	42	Tashkent	550
15	Fergana	435			
16	Kitab	460		Not noted	
	3-4 points		43	Shaartuz	265
			44	Termez	295
17	Dagana	165	45	Denau	335
18	Khirmandzhou	170	46	Karki	525
19	Moskovskiy	175			
20	Gissar	180			
21	Parkhar	180			
22	Pyandzh	190			
23	Leninabad	435			
24	Urgut	460			
25	Andizhan	490			
26	Samarkand	495			

Table 6. Macroseismic Data on the Earthquake on 26 March

No, in order	Location	Δ, km	No, in order	Location	Δ, km
	4 points		5	Andizhan	265
1	Tuzbel'	215	6	Namangan	315
2	Russkoye Selo	240	7	Karavan	360
			8	Terek-say	385
	3 points			2-3 points	
3	Osh	225	9	Dushanbe	420
4	Fergana		10	Tashkent	480

In Southern Tian Shan in 1973 the seismic energy released was lower by approximately 1.5 orders of magnitude than in Pamir. As can be seen from the graph of the total energy and the maps of the epicenters, this is the lowest level for all the years, which was observed only in 1963. A large number of the epicenters gravitate toward the boundary with the preceding zone. This is true of the earthquakes in this zone with K=12 (Nos 30, 67, 10, 63). The first of them is included in the above-mentioned group of six earthquakes, the second and third are included in the chain of four earthquakes with K=12, with the latter region having activated considerably as compared with 1972, when only one earthquake with K=12 was recorded here. The following earthquake bounds on the north the chain of epicenters extended almost along the meridian in the region of the Kokshaal-Tau Range. This focus was more active in 1972, when one earthquake with K=14 was recorded here, and two with K=12.

The next zone, Central Tian Shan, is in second place with respect to the total seismic energy released in 1973. As compared with 1972, this zone was considerably activated, and reached the average level characteristic of it of seismic energy emission. The amount of seismic energy released here, however, is lower by one order of magnitude than in the highest seismic Pamir. In this zone one earthquake with K=13 and two with K=12 were registered. All of them were located in the eastern, more seismic mountain part of this zone. The western, lower part, however, is weakly seismic. Notice should be made of the group of two strong (Nos 11, 15) and several dozen weaker jolts in the central part of the Fergana Range. The strongest of them occurred on 6 February at 20:37 (K=12) and on 18 February at 21:39 (K=13).

The shocks produced by the first of them in the village of Konduk, 60 km away, reached 6 points. It was felt in the settlement of Gul'cha, 90 km away, but in the village of Kara-Kul'dzha (60 km) it was not felt. The second earthquake, 225 km away, in Andizhan, was estimated at 3-4 points, but in Naryn (175 km) it was not noticed.

Several dozen earthquakes of lower energy classes were registered in the mountain ranges surrounding the Fergana Valley.

In 1973, just as in the preceding year, Northern Tian Shan was the least seismic, where the amount of energy released was the lowest in all the years of observations. In this region there were only two earthquakes with K=12, and the total number of them scarcely reached 40. Seismic energy was released here lower by two orders of magnitude than in neighboring Central Tian Shan. A large number of the earthquakes in this zone were concentrated in the northeastern part of the Kirgiz Range. The strongest of them (K=12) was recorded on 1 September at 12:32 (No 49). Along with the earthquake on 14 April at 19:49, which occurred in the central part of the Terskey-Alatau Range (K=12), and two dozen weaker jolts, it may serve as an indicator of the level of seismicity in the mountain vicinity of Lake Issyk-Kul'. As compared with 1972, the number of earthquakes here was considerably less. This, apparently, indicates the further stabilization in the level of seismicity in this region since the Sarykamysh earthquake in 1970.

The zone of deep Pamir-Hindukush earthquakes extends in a narrow, but very dense chain from the southwest to the northeast, along the northern spurs of Hindukush, turning at the ends and taking on an S-shape. In 1973, in both the earth's crust and below its base, the amount of seismic energy released was approximately identical. There was one earthquake with K=14 under the crust, just as in Southern Tian Shan. As for earthquakes of weaker energy classes, for each of them the number of earthquakes under the crust was approximately double that in Southern Tian Shan. The exception is constituted only by earthquakes with K=9, which are not representative throughout the territory of Central Asia [3].

The strongest earthquake here was on 17 October at 03:16 (No 61) with K=14, which occurred in the central part of Hindukush (Fig. 8, Table 5) in a region of a turn in the area of the focal points of these earthquakes toward the west. It caused 4-5-point vibrations in Shagon (175 km), Imeni Vose (190 km), Kulyab (192 km) and Vancha (210 km).

During 1973, in essentially this same area, 20 more strong earthquakes were registered (Nos 14, 16, 17, 23-25, 34, 36, 40, 42, 43, 46-48, 50, 54-56, 59, 62), among which 4 had K=13. Information on their perceptibility is not available to us. Adjoining them on the west is a more dispersed group of epicenters of earthquakes, among which two had K=13 and seven--K=12.

From the northeast of the earthquake on 17 October the epicenters extended along the northern slopes of Hindukush. Among them were 2 with K=13, 6 with K=12 and a series of 300 weaker jolts. They were very densely located up to the Rushan Range, where they are completed with an earthquake on 25 April at 03:16 (No 28). It was felt with the greatest intensity, equal to 3-4 points, at Garma (205 km), Kulyab (210 km), Kaynar and Kaduch (220 km); at Horog (65 km), Sadvinsovkhoz (215 km), Obigarm (230 km) and Kyzylsu (250 km)--3 points.

Next follow several dozen weak earthquakes, which are completed at the Sarykol Range by a group of five strong ones (K=12) and several weaker jolts. Two of them (Nos 19, 20) have an energy class of K=13. The first, which occurred on 26 March at 07:58, was felt with the greatest intensity of 4 points in the village of Tuzbel', 215 kilometers away.

Table 6 gives information on the perceptibility in the rest of the population centers.

Catalog of Earthquakes in Central Asia With K $\geqslant$ 9 in 1973

№ п/п	Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага	Класс точности	K	№ района	Макросейсмические данные
			φ^{o}N	λ^{o}E					
1	2	3	4	5	6	7	8	9	10

Key:

1. Number, in order
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ °N
5. Coordinates of epicenter: λ °E
6. Focal depth, in km
7. Accuracy class
8. K
9. Number of region
10. Macroseismic data

January

	1	05 04 41	36,4	71,2	80	Б	9	1	
		09 27 43	36,6	71,1	250	Б	10	1	
		23 03 03	36,4	71,0	220	Б	9	1	
	2	07 58 44	36,5	70,4			9	1	
		12 06 30	38,50	69,73	1–2	6	9	3	
		13 10 27	36,5	70,1	230	Б	9	1	
		16 25 36	36,5	71,0	100	Б	11	1	
		21 14 35	37,2	74,9			10	2	
	3	04 32 43	36,6	70,2	220	Б	10	1	
		08 04 04	39,2	72,0		Б	9	3	
		08 09 24	39,0	71,8		Б	9	3	
		09 12 32	39,0	71,8		Б	9	3	
		14 29 58	39,1	71,5		А	10	3	
1		14 31 01	39,2	71,8	10	А	14 (M=5,2)	3	See text
2		15 05 14	39,1	71,8		Б	12	3	Андижан, 2 балла
		16 07 58	39,0	71,8		Б	10	3	
		16 42 28	36,9	71,0	230	Б	9	1	
		17 05 03	39,0	71,8		А	9	3	
		17 05 05	36,5	71,1	130	Б	11	1	
		17 14 51	39,0	71,8		Б	9	3	
		20 36 04	39,1	71,8		А	11	3	
		22 45 03,0	41,07	73,27	12	а	9	8	
		23 34 15	39,2	72,0		Б	9	3	
	4	00 10 51	37,3	69,2		Б	9	2	
		05 31 09	39,4	72,1		Б	10	3	
		07 11 48	37,1	72,4		Б	9	2	
		14 00 26	36,7	70,2	210	Б	9	1	
		14 22 37	36,5	70,8		Б	10	1	
	5	00 57 57	40,3	71,9	5	А	9	8	
		03 11 04	38,8	72,4		Б	9	3	
		03 45 17	37,3	71,7	120	Б	9	2	
		09 31 22	40,1	77,5		Б	11 (M=3,7)	5	

1	2	3	4	5	6	7	8	9	10
		20 10 06	38,70	70,30	10	б	9	3	
		20 14 42	38,70	70,30	10	б	11	3	
	6	02 42 56	36,7	69,4	150	Б	9	1	
		13 24 01	39,8	77,4		Б	11	5	
		18 48 56	36,7	71,0	150	Б	9	1	
	7	00 28 40	36,4	70,8	80	Б	9	1	
		06 03 08	39,6	77,6		Б	9	12	
	8	11 26 53	36,6	70,2	220	Б	11	1	
		12 24 20	37,2	71,5	160	Б	9	2	
		12 26 05	36,6	71,2	80		10	1	
		14 07 21	36,4.	71,1	80	Б	10	1	
	8	14 09 51	40,9	80,9		А	10	12	
		18 51 46	36,5	71,0	240	Б	9	1	
	9	06 24 16	37,3	71,5	130	Б	10	2	
		07 21 43	39,3	74,4			9	11	
		13 33 59	36,3	70,0	180	Б	9	1	
3		16 17 50	39,5	73,9		Б	12	11	
		17 06 46	39,9	69,0	5	А	9	5	
	10	01 23 46	36,4	71,0	100	Б	9	1	
		11 53 14	39,1	71,9		Б	10	3	
		21 07 45	36,2	70,9	100	Б	11	1	
	11	00 52 58	44,5	80,6		А	10	13	
		02 12 21	36,3	71,0	80	Б	10	1	
		04 04 40	36,6	70,8	80	Б	11	1	
		06 43 00	36,9	70,6			10	1	
	12	11 09 04	36,1	70,5	80	Б	9	1	
		11 20 15	38,7	72,4		Б	9	3	
		16 19 57	41,0	72,5	5	А	9	8	
		16 59 30	36,6	70,6	220	Б	10	1	
		17 07 29	36,4	71,1	80	Б	10	1	
		17 35 42	38,42	70,44	5	б	11	3	
		19 48 51,2	43,90	75,80	34	б	9	16	
		20 22 53	38,5	73,9	160	А	11	2	
4		23 39 25	36,1	70,6	120	Б	12 (m = 5,4)	1	Душанбе, 2 балла
	13	16 36 58	38,4	72,9	130	Б	9	2	
		23 18 27	36,6	71,0	140	Б	10	1	
	14	06 09 27	36,7	69,8	220		10	1	
		20 40 51	36,7	70,9	140	Б	9	1	
	15	07 57 41	36,5	70,1	230	Б	10	1	
		08 11 03	38,9	70,4		А	10	3	
		08 23 56	38,9	70,3		А	9	3	
		11 37 20	39,3	72,2		Б	9	3	
		19 47 49	40,5	76,9		Б	9	5	
5		23 20 48	36,6	69,3	150	Б	12	1	
	16	02 23 54	39,3	73,0		Б	10	3	
		15 20 25	37,0	71,5	140		9	2	
		15 26 18	36,5	71,0	150	Б	9	1	
		16 19 50	36,2	70,9	80	Б	9	1	
		18 08 40	36,4	70,4	150	Б	10	1	
	17	09 23 23	36,1	68,9	80	Б	9	1	
		22 23 19	36,5	70,5	200		9	1	
	18	02 08 26	37,3	71,8		Б	10	2	
		09 54 15	37,5	72,0	210	Б	10	2	
		18 24 04	36,1	70,9	100	Б	9	1	
		22 49 09	37.3	72,0	210	Б	9	2	

1	2	3	4	5	6	7	8	9	10
	19	01 04 22	36,4	70,2	160	Б	9	1	
		18 42 59	36,1	70,2	80	Б	11	1	
		20 46 01,5	40,05	73,07		а	10	5	
		22 41 46	37,1	71,9	100	Б	9	2	
	20	06 00 11	37,2	71,4	130		10	2	
		19 30 46	36,7	70,2	220	Б	10	1	
	21	03 23 44	39,1	71,2		Б	11	3	Джиргаталь, 3 балла
		08 22 31	39,2	71,2		Б	10	3	
		13 41 17	36,5	71,0	100	Б	10	1	
		18 32 28	36,9	70,6			9	1	
	22	01 15 25	36,9	70,9	70	Б	9	1	
		02 12 19	37,0	70,8	210	Б	10	1	
		04 56 21	37,3	71,7	160	Б	9	2	
		07 59 09	42,1	75,8		А	9	6	
		17 20 53	36,7	70,8	220	Б	9	1	
	23	00 25 02	38,5	73,4	110	Б	9	2	
		18 11 26	36,7	70,5	220	Б	9	1	
	24	06 49 42	41,8	72,6	5	А	9	9	
		07 37 12	43,5	77,9		А	10	7	
		12 52 50	36,2	74,2			10	2	
		18 17 46	36,3	70,6	130	Б	9	1	
	25	02 25 39	41,2	71,9	10	А	10	8	Афлатун, 3–4 балла
		05 05 16	37,2	71,6	210	Б	9	2	
		09 13 56	38,2	67,4		Б	9	4	
6		12 01 25	36,5	70,0	180	А	12	1	
	26	00 35 27	36,7	71,3	180	Б	10	1	
		05 01 10	40,0	72,0		Б	9	5	
		06 22 20	39,6	75,2		Б	9	11	
		11 35 19	36,4	70,6	200	Б	10	1	
		21 13 10,1	40,40	74,15		а	10	5	
	27	00 01 46	36,9	70,8		Б	10	1	
		08 58 15	37,3	71,9	100	Б	11	2	
		19 44 42	40,2	77,8		Б	9	5	
	28	03 32 45	39,00	70,43	10	б	10	3	
		07 49 44	36,5	71,0	150	Б	10	1	
		13 11 00	38,75	70,38	2–3	б	9	3	
7	29	04 32 08	36,3	73,3		Б	12	2	
		18 31 14	36,6	71,1		Б	10	1	
	30	03 56 28	36,3	70,8	210	Б	10	1	
		12 42 47	37,4	72,1	220	Б	9	2	
	31	06 13 44,9	41,37	73,93	16	а	9	6	
		07 31 20	39,7	75,9		Б	9	12	
		09 45 26	41,8	79,3		А	9	5	
		15 24 28	37,2	69,6		Б	9	2	
		16 54 56	37,2	69,7		Б	9	2	
		22 36 38	37,1	69,5		Б	9	1	
8		22 49 02	37,1	69,5		Б	12	1	
		23 15 46	37,1.	69,6		Б	10	1	

1	2	3	4	5	6	7	8	9	10
				February					
	1	09 21 46,6	40,90	73,00	20	a	9	8	
		10 37 21	37,5	71,8	210	Б	9	2	
		12 46 56	36,3	71,0	110	Б	10	1	
		13 52 56	37,2	71,3	100	Б	10	2	
		18 28 16	37,1	69,5		A	11	1	
		20 43 55	36,4	70,0	240	Б	9	1	
		22 10 07	37,0	69,7		Б	10	1	
		22 58 30	37,2	69,6		A	10	2	
		23 56 23	36,7	70,9	220	Б	9	1	
	2	07 53 32	36,2	69,9	100	Б	9	1	
		08 52 51	37,2	71,5	130	Б	10	2	
		18 35 13	43,4	67,2	5	A	9	20	
		19 25 58	36,4	70,5	150	A	10	1	
	3	00 22 35	37,2	71,5	120	Б	9	2	
		01 59 54	37,0	70,7			9	1	
	3	03 35 28	36,6	70,8	220	Б	9	1	
		15 11 14	42,6	68,7	20	A	9	10	
		17 37 27	36,3	70,4	190	Б	10	1	
		21 06 52,2	40,60	72,47		a	9	8	
		21 29 32	36,6	70,2	190	A	10	1	
		21 33 18	36,5	70,3	200		9	1	
	4	07 13 08	37,4	69,8		Б	9	2	
		10 44 25,7	40,50	73,63		a	9	5	
		10 59 29	36,7	71,1	180	Б	9	1	
		14 45 44	36,4	70,0	240	A	11	1	
		16 29 12	36,5	70,2	190		9	1	
		17 34 18	36,9	71,6	160	A	10	2	
9	5	00 19 59	38,83	70,07	10	б	12	3	
		17 45 07	36,7	71,1	180	Б	10	1	
	6	02 36 09	40,1	78,4		A	9	5	
		02 58 27	36,4	71,1	100	Б	10	1	
10		13 24 02	39,8	77,2		Б	12 ($M = 4,3$)	5	
		17 17 56	36,4	70,8	240	Б	9	1	
11		20 37 43,2	41,00	74,10		a	12 ($M = 4,2$)	6	See text
		20 59 30,6	40,90	74,20		a	10	6	
		21 24 29,9	40,95	74,20		б	9	6	
		22 23 09	36,6	70,7	190	Б	9	1	
		23 18 27	39,23	71,21	35	a	10	3	
	7	11 33 17	40,3	70,4	25	A	10	8	
		14 05 38	36,7	68,3			10	1	
		22 38 06	36,6	67,7		Б	11	1	
	8	00 29 22	38,4	73,4		Б	10	2	
12		01 08 51	37,3	69,2		A	12	2	Пархар, 3 балла
13		02 28 01	36,6	68,3		Б	12	1	
		06 46 20	41,9	79,7		A	9	5	
		07 03 06	36,3	68,0		Б	9	1	
		09 22 24	36,8	72,3			10	2	
		20 05 49	40,5	79,2		A	9	12	
	9	02 29 40,2	39,67	65,95	10	a	9	22	
		07 33 15	36,6	71,0	150	Б	9	1	
		09 37 46	36,8	71,6	270	Б	10	1	
		17 30 40	37,4	71,3	90		9	2	
		21 20 30	42,7	79,8		A	9	6	

1	2	3	4	5	6	7	8	9	10
	10	00 02 54	37,3	71,5	130	Б	10	2	
		04 02 49	39,11	70,30	5	б	11	5	
		09 03 01	37,4	71,9	150	Б	10	2	
		22 21 49	41,9	72,2	15	А	9	9	
	11	02 50 45	36,6	70,7	220	Б	9	1	
		05 14 59	38,25	69,33	1–2	а	9	3	
		07 12 40	37,5	68,5		Б	10	4	
		10 57 52	44,2	76,7		А	9	15	
		14 38 58	36,4	71,1	100	Б	11	1	
	12	00 19 40	37,67	69,83	10	б	11	2	See text
		00 23 32	37,67	69,83	10	б	9	2	
		07 01 05	37,72	69,80	5	б	11	2	
		07 06 46	37,70	69,83	2–3	б	10	2	
		19 18 49,0	42,20	76,75	10	а	10	6	
	13	10 53 43	36,5	70,2	180	Б	9	1	
		12 33 20	39,8	73,0			9	5	
		13 30 21	38,52	70,55	5–10	б	10	3	
		15 55 59	36,4	70,5	140	Б	11	1	
		16 50 12	37,2	71,2	80	Б	9	2	
		17 24 41	38,50	70,49	5	а	9	3	
		17 48 07	38,50	70,50	5	а	9	3	
		19 56 50	39,5	74,3		А	10	11	
	14	02 54 13	37,7	71,6	250		9	2	
14		12 28 35	36,5	70,7	170	Б	13	1	
		13 18 31	36,4	67,7			9	1	
		20 07 20	46,1	78,5		А	10	13	
		20 15 55	36,2	68,2	140	Б	9	1	
	15	09 06 04	38,41	70,04	20	а	10	3	
		16 19 59	38,40	68,58	1–2	б	9	4	
		17 19 17	37,1	71,3	110	А	11	2	
	16	01 02 50	36,9	71,1	90	Б	9	1	
		01 55 49	37,2	71,6	140		9	2	
		10 31 44	38,29	69,33	2–3	б	9	3	
		16 37 04	43,1	78,5		А	9	7	
	17	01 56 57	37,2	71,2	80	Б	9	2	
		17 18 47	37,2	71,2	90	Б	10	2	
		17 27 02	36,2	70,9	100	А	10	1	
	18	00 33 48	37,69	69,82	10	б	10	2	
		00 35 22,8	40,93	73,03	19	а	9	8	Серный рудник, 3 балла
		08 16 18	37,67	69,83	10	б	10	2	
		13 10 08	37,2	71,8	170	Б	9	2	
15		21 39 01	40,7	74,2	30	а	13 ($M = 4,7$)	6	Андижан, 3–4 балла
		22 41 57,7	40,85	74,20		а	9	6	
	19	07 28 47	39,3	72,6			9	3	
		19 56 49	39,7	73,9		А	10	11	
		21 09 10	37,69	69,82	5	б	9	2	
		23 03 01	36,2	70,9	100	Б	11	1	
	20	02 20 45	36,1	69,5	90	Б	9	1	
		13 25 46	36,6	70,5	220		9	1	
		13 39 57	38,25	69,28	1–2	б	9	3	
		22 07 30,3	40,90	74,17		б	10	6	

1	2	3	4	5	6	7	8	9	10
	21	10 32 39	39,4	74,3			9	11	
		11 46 11	36,5	71,0	80	Б	10	1	
		16 08 03	36,4	71,1	70	Б	10	1	
		18 35 43	36,6	70,8	210	Б	9	1	
	22	03 01 07	37,2	70,7			10	2	
		11 24 13	37,2	71,8	200		9	2	
	23	17 03 07	38,28	69,31	1–2	б	9	3	
		20 04 47	37,2	71,3	90	Б	9	2	
		23 15 32	38,75	69,94	2–3	б	9	3	
		23 39 01	38,9	72,9		Б	9	3	
	24	00 48 39	36,4	71,1	80	Б	9	1	
		02 02 28	36,6	70,8	220	Б	10	1	
		09 16 24	38,6	73,3	70	Б	11	2	
		17 11 54	36,6	68,2			10	1	
		18 23 51	36,4	68,2			9	1	
		18 52 09	39,8	74,3		Б	9	11	
		22 15 46	36,4	71,3	140	Б	9	1	
	25	00 16 04	38,83	70,18	10	б	9	3	
		00 52 17	36,6	70,7	230	Б	10	1	
	25	07 37 52	36,4	69,7	150	Б	10	1	
	26	01 12 19,9	40,32	68,68	15	a	9	10	
		02 07 09	36,6	71,1	220		9	1	
		03 40 41,6	42,27	74,85	10	a	9	7	
		20 09 29	38,28	69,31	1–2	б	9	3	
		20 22 26	36,3	73,4		Б	10	2	
	27	00 35 06,0	42,10	74,87	10–50	a	9	7	
		19 27 35	36,6	71,0	240	Б	9	1	
	28	06 25 17	36,6	70,7	220	Б	10	1	
		07 22 08	38,29	69,40	1–2	б	9	3	
		11 04 38	36,6	70,5	210	Б	10	1	
16		14 48 47	36,6	71,0	270	Б	12	1	
		19 29 40	37,6	72,2	200	Б	9	2	
					March				
	1	12 45 04	39,9	70,0		Б	9	5	
		19 57 35	36,9	71,2	80	Б	10	1	
	2	01 49 53	36,7	71,5	100	Б	10	1	
		05 13 43	38,5	73,0	100	Б	10	2	
		12 00 11	39,5	73,9		Б	11	11	
		16 34 00	36,4	69,6	100	Б	10	1	
		21 48 22	36,5	69,4	190	A	9	1	
	3	05 57 32	36,6	70,7	200	A	11	1	
		10 22 48	40,2	79,0	52	Б	11 (M = 4,5)	5	
		11 22 35	38,32	69,35	1–2	б	9	3	
	4	06 00 26	40,6	77,5			9	5	
		07 03 08	42,0	79,3			9	5	
		10 20 52	39,03	69,82	22	a	9	5	
	5	05 02 56,9	41,17	73,90		б	9	6	
		10 49 36,2	42,63	77,60	25	a	9	7	
		13 55 52	38,5	73,1	120	Б	9	2	
		20 11 46	36,5	70,7	180	Б	9	1	
		21 21 17	36,4	67,9		Б	11	1	
		23 13 15	37,7	72,0	130	Б	9	2	

1	2	3	4	5	6	7	8	9	10
	6	01 52 12	40,5	77,3		Б	9	5	
		02 45 05	37,4	72,1	190	Б	9	2	
		10 19 40	36,5	70,0	200	Б	9	1	
		16 05 23	37,67	69,85	10	б	9	2	
		18 10 23	36,7	70,9	230	Б	10	1	
		19 35 48	36,4	70,9	80	А	10	1	
17	7	07 07 43	36,5	71,0	80	А	12	1	
		14 07 40	36,2	70,5	80	Б	10	1	
	8	02 10 53	37,3	72,0	180	Б	9	2	
		06 33 58	37,5	72,0	210	Б	9	2	
		17 56 08	37,3	71,4	100	Б	9	2	
		18 40 44	37,68	69,78	10	б	11	2	See text
		18 45 14	37,68	69,78	10	б	9	2	
		18 45 19	37,68	69,78	10	б	9	2	
		20 38 17	36,2	70,4	80	Б	9	1	
		23 10 12	38,23	69,28	1–2	б	9	3	
	9	09 10 52	37,0	71,6	150	Б	10	2	
		15 17 19	37,3	72,2	240	Б	10	2	
		16 51 59	36,5	70,1	200	А	11	1	
		23 37 18	38,27	69,25	2	б	9	3	
	10	01 35 17	40,5	74,4		Б	9	5	
		03 09 15	36,7	71,0	230	А	10	1	
		12 45 39	41,0	75,2		Б	9	6	
		14 45 31	39,00	70,69	8	а	10	3	
		16 12 03	36,5	70,6	130	А	10	1	
		19 57 53	37,0	71,1	80	Б	11	2	
		20 27 01	37,65	69,79	10	б	9	2	
		22 42 36	39,3	72,4		А	11	3	
	11	06 50 52	36,6	70,7	140	Б	10	1	
		09 51 11	37,67	69,79	10	б	9	2	
		13 22 57,0	42,83	72,10		а	9	7	
		13 32 19	36,5	69,6	140	Б	10	1	
		22 17 15	38,29	69,38	1–2	а	9	3	
	12	03 30 00	39,8	76,7		А	10	5	
		06 39 38	36,4	71,0	100	Б	9	1	
		13 01 36	36,6	71,0	230	Б	9	1	
	13	03 23 01	38,28	69,36	1–2	б	9	3	
		09 32 35	40,0	75,5		Б	9	5	
		13 04 44	39,7	74,0		Б	9	11	
		17 05 07	38,22	69,29	1–2	б	9	3	
		17 11 23	42,8	79,1		А	9	6	
	14	02 02 39	36,5	70,8	220	Б	10	1	
		03 27 42	38,4	72,4		Б	10	2	
		07 15 35	38,77	69,78	1–2	а	9	3	
		19 14 12	36,8	70,5		Б	9	1	
	15	14 13 20	37,1	71,3	100	Б	10	2	
		21 46 49	36,6	70,9	230	Б	11	1	
	16	01 21 50	37,1	70,8		Б	11	2	
	17	06 31 11	39,5	67,81	5	А	9	5	
		10 53 46	38,1	72,4		Б	10	2	
18		12 19 07	38,5	74,1	130	Б	12 ($m = 4,5$)	2	
		12 56 34	41,3	79,1		А	9	5	

1	2	3	4	5	6	7	8	9	10
	18	01 27 53	37,1	72,9		Б	10	2	
		04 37 37	38,37	69,40	1–2	а	9	3	
		12 40 06	37,2	71,5	220	Б	10	2	
		14 16 47	36,4	70,5	200	Б	10	1	
		14 49 05	36,5	70,1	230	Б	9	1	
	19	22 04 23,0	42,25	78,90	20	б	10	6	
		23 48 46,0	42,83	77,38	10–12	а	9	7	
	20	00 38 32	36,4	70,4	160	Б	10	1	
		00 42 51	36,7	71,1	250	Б	10	1	
		05 56 21	37,5	72,0	210	Б	9	2	
		11 36 33	40,7	74,3		А	9	5	
	21	12 39 23	36,7	71,2	190	А	11	1	
		13 52 00	36,6	70,7	180	А	10	1	
		22 31 02	36,4	70,9	110	Б	10	1	
	22	05 14 04	36,8	71,0	180		9	1	
		05 20 13	38,6	72,1		Б	10	3	
		13 50 07	36,5	70,9	80	Б	9	1	
		17 50 53	37,6	72,1	200	А	10	2	
		18 35 06	36,5	70,3	210	Б	11	1	
		21 31 48	36,3	69,2	160	Б	10	1	
	23	09 05 52	36,3	68,7		Б	10	1	
		10 04 57	37,5	72,1	200	Б	10	2	
		17 23 19	36,7	71,1	80	Б	10	1	
	24	04 34 44	40,2	77,2		Б	9	5	
					March				
	24	07 48 59	41,0	78,9		Б	10	5	
		16 36 29	44,7	78,6		А	9	13	
		20 53 05	38,75	70,03	10	б	9	3	
	25	14 05 46,0	40,99	74,37		а	9	6	
	26	03 15 22	37,3	70,5			9	2	
		04 32 48	41,4	71,8	5	А	9	8	
		06 01 53	38,62	70,51	5	б	10	3	
		07 46 41	37,1	71,2	100	Б	9	2	
19		07 58 42	38,4	73,9	116	Б	13	2	
							(m = 5,8)		See text
20		08 33 31	38,4	73,9	120	Б	13	2	Андижан, 2 балла
							(m = 5,1)		
		08 44 45	38,5	73,8	110	Б	10	2	
		18 03 48	39,3	72,1		Б	9	3	
		19 16 48	36,7	71,3	180	А	10	1	
		20 17 07	39,4	73,0		Б	10	3	
	27	00 21 57	37,1	71,1	80	Б	10	2	
		08 36 05	36,8	71,5	80	Б	10	1	
		08 53 20,3	42,10	75,70	10–15	а	10	6	
		11 29 47,7	40,30	69,25	5	б	9	8	
		21 19 20	37,2	70,1		Б	10	2	
		23 21 28	36,9	71,1	240		9	1	
	28	02 35 33	36,4	70,8	80		9	1	
		08 33 06	39,6	74,4			9	11	
		16 15 07	36,5	70,9	80	Б	9	1	
		20 20 15	39,17	70,31	10	б	9	5	
		20 43 26	36,4	70,3	200	Б	10	1	
		22 49 33	40.1	77.1		Б	9	5	

1	2	3	4	5	6	7	8	9	10
	29	06 19 45	36,4	71,7	80		10	1	
		10 23 53	36,4	71,0	130	А	11	1	
		11 16 12,3	41,23	72,70		а	10	8	
		16 44 56,5	41,21	72,75	25	б	10	8	
	30	01 11 08	36,5	70,8	200	Б	9	1	
		05 51 08	39,6	69,6	30	А	9	5	
		08 37 30	36,5	70,8	150	Б	9	1	
	31	01 08 20	38,41	70,05	7–8	б	9	3	
		05 04 43	36,5	70,4	200	Б	10	1	
		07 16 27	36,5	70,1	210	Б	9	1	

April

1	2	3	4	5	6	7	8	9	10
	1	09 16 38	36,4	71,1	140	А	10	1	
		09 45 16	40,3	72,3	10	А	11	8	
		13 00 54	38,67	70,29	10	б	9	3	
		14 30 25	38,6	72,1		А	11	3	
		14 35 39	38,6	72,1		А	10	3	
		16 57 40	37,67	69,82	10	б	9	2	
		22 43 53	36,5	70,1	200	Б	10	1	
	2	00 21 16	37,67	69,82	10	б	9	2	See text
21		02 43 21	37,71	69,77	53	б	13 ($M = 5,2$)	2	
		03 09 32	37,69	69,77	10	б	10	2	
		03 52 13	37,69	69,77	10	б	9	2	
		03 57 55	37,72	69,79	10	б	11	2	им. Восе, 3–4 балла
		04 04 30	38,01	69,68	2–3	б	11	3	
		06 52 18	37,69	69,83	10	б	9	2	
		10 42 44	37,68	69,83	10	б	9	2	
		12 03 03	36,4	70,6	210	Б	10	1	
		22 28 01	37,6	69,9	10	А	9	2	
		22 45 12	37,67	69,78	10	б	9	2	
	3	02 28 32	37,64	69,73	10	б	10	2	
		05 50 22	37,69	69,82	5	б	11	2	Куляб, 4–5 баллов; им. Восе, 3 балла
		06 30 56	37,77	69,92	2–3	б	9	2	
		06 31 38	37,7	69,9	2–3	А	11	2	Куляб, 4–5 баллов
		07 36 37	36,4	70,5	210	А	10	1	
		08 12 17	37,67	69,82	2–3	б	10	2	
		13 22 28	39,2	66,9	10	А	9	5	
		14 42 43	37,2	71,9	210	А	10	2	
		15 24 17	37,71	69,83	5	б	9	2	
		22 05 30	37,68	69,81	2–3	б	10	2	
		22 19 34	37,69	69,77	10	б	11	2	Куляб, 5 баллов; им. Восе, 4–5 баллов
		22 25 38	37,68	69,83	10	б	9	2	
		23 12 30	37,67	69,83	10	б	10	2	
		23 22 36	37,67	69,83	10	б	9	2	
	4	00 34 59	37,67	69,82	2–3	б	10	2	
		01 16 43	37,65	69,85	10	б	10	2	им. Восе, 3 балла
		12 11 25	37,69	69,82	2–3	б	9	2	
		22 10 12,5	39,30	74,90		б	11	11	
		23 13 23	37,3	72,7		А	10	2	

1	2	3	4	5	6	7	8	9	10
	5	08 56 29	36,4	68,2			10	1	
		14 13 18	36,4	68,2			10	1	
		21 23 38	36,5	70,8	130	Б	9	1	
	6	16 16 23	36,7	71,3	100	Б	9	1	
22		16 57 31	38,2	74,1	150	Б	12	2	
							($m = 4,9$)		
		19 31 48	36,4	70,8	130	Б	10	1	
	7	10 51 04	42,0	67,8	15	А	9	20	
		12 18 17	42,3	67,5	5	А	9	20	
23	8	01 22 26	36,5	71,2	230	А	12	1	
		05 57 54	37,4	71,1	70	Б	10	2	
		12 09 07	37,70	69,77	2–3	б	9	2	
	9	03 00 43	37,74	69,85	2–3	б	9	2	
		21 34 24	36,2	70,4	130	Б	9	1	
		21 40 43	36,7	66,7			9	1	
		22 54 02	36,8	66,6			10	1	
		23 23 18	37,74	69,85	2–3	б	9	2	
	10	06 37 34	37,68	69,80	2–3	б	9	2	
		07 21 02	41,8	68,2	15	А	9	10	
		13 29 51	37,3	71,6	120	А	10	2	
24		18 07 49	36,7	71,3	120	А	12	1	
							($m = 5,0$)		
		21 27 24	37,71	69,82	2–3	б	11	2	Куляб, 4–5 баллов
		22 18 31	38,43	69,43	2–3	а	10	3	
		22 28 23	38,60	70,50	5	б	10	3	
	11	05 06 52	39,7	77,4		Б	9	5	
		07 10 21	36,0	70,2	140	Б	9	1	
		09 26 52	36,6	71,2	150	Б	10	1	
		10 38 22	42,4	67,8	5	Б	9	20	
	11	11 32 12	36,6	71,2	200	А	10	1	
		12 06 16	36,2	69,8	140	Б	10	1	
	12	02 40 09	37,2	71,5	130	А	10	2	
		08 24 42,6	41,75	72,63	10	а	10	9	
25		08 31 06	36,4	70,9	180	А	13	1	
							($m = 5,0$)		
		21 39 31,0	40,85	72,60		б	9	8	
	13	00 24 43,2	41,13	75,30	10	а	9	6	
		01 12 48	36,6	71,2	150	Б	9	1	
		01 35 34	36,5	70,2	190	Б	9	1	
		04 13 17	36,5	70,3	210	Б	10	1	
		07 24 23	36,7	70,8		Б	9	1	
		09 24 47	39,0	67,1	5	А	9	5	
		13 16 40	40,6	72,9	5	А	9	8	
		19 44 56	38,61	70,64	10	б	10	3	
	14	01 50 32	36,4	70,1	210	Б	10	1	
		04 58 00	36,5	70,8	210	Б	10	1	
		06 08 40	36,5	70,0	240	А	10	1	
		10 41 59	36,8	71,2	80	Б	10	1	
		16 04 49	36,1	70,2	100	Б	11	1	
		17 43 54	37,6	72,2	210	А	9	2	
26		19 49 44,5	41,93	77,40	15	а	12	6	
		20 02 02	36,8	70,8		Б	11	1	
		20 31 15	36,5	70,2	220	А	11	1	
	15	00 36 36	36,4	70,7	210	А	10	1	
		04 02 07	38,3	73,6	130	А	10	2	
		20 15 27	36,4	69,0	160	Б	9	1	

1	2	3	4	5	6	7	8	9	10
	16	05 41 20	36,6	69,7	270	Б	10	1	
		06 22 44	37,67	69,80	2–3	б	10	2	
		10 23 45	38,93	70,77	5	а	10	3	
	17	08 01 41	36,3	68,3		Б	9	1	
	18	04 41 07	36,4	71,1	80	А	10	1	
		06 58 12	36,4	70,0	200	Б	9	1	
		07 08 32	37,1	71,7	150	А	9	2	
		10 36 38	38,47	69,23	2–3	б	9	4	
		10 43 17	36,5	70,5	250	А	11	1	
		19 15 39,6	39,45	73,80		б	9	3	
	19	05 43 39	36,2	68,5		Б	10	1	
		17 44 57	37,67	69,87	5	б	9	2	
		19 31 33,0	43,30	71,27		б	9	18	
		19 58 59	38,6	72,7		Б	9	3	
		23 15 34	37,2	71,8	210	А	10	2	
	20	00 49 26	44,4	80,7			9	13	
		02 23 49	36,5	71,0	110	А	11	1	
		11 13 28	40,2	77,5		Б	9	5	
		16 00 25	39,4	68,1	5	А	9	5	
		19 25 33	40,2	77,5		Б	9	5	
		21 12 52	36,5	71,0	100	А	10	1	
		22 58 58	37,3	71,8	170	А	9	2	
	21	00 28 35	38,0	74,0	180	Б	10	2	
		04 00 51	40,2	77,6			10	5	
		04 11 54	40,5	77,7		Б	10	5	
27		04 29 20	38,88	70,42	5	б	12	3	See text
		05 31 20	38,9	70,5	10	А	10	3	
		09 51 55	37,3	71,6	250	Б	9	2	
		11 24 03	36,7	72,2	80	Б	10	2	
		13 24 58	41,0	73,7	25	Б	11	6	Узген, 3 балла
		13 59 08,3	41,07	73,83		б	9	6	
		15 14 40	41,0	73,9	15	А	9	6	
		15 30 17	37,3	69,7		А	10	2	
	22	00 21 03	36,5	71,0	130	Б	9	1	
		01 31 31	36,9	71,5	120	А	9	2	
		02 25 55	36,8	70,6	250	Б	9	1	
		03 54 19	36,5	70,8	140	А	9	1	
		12 17 21	36,5	70,6	220	А	11	1	
		12 35 13	40,7	77,7			9	5	
		17 14 45	36,5	70,3	210	А	10	1	
	23	00 08 24	38,4	73,3	130	А	11	2	
		00 20 29	38,52	70,47	8	а	9	3	
		03 04 16	37,2	71,6	100	А	10	2	
		16 13 59	38,25	69,33	1–2	б	9	3	
		16 47 46	38,25	69,33	1–2	б	9	3	
		21 37 23	38,94	70,53	23	а	9	3	
		23 02 10	40,0	70,6	15	А	10	5	Исфара, 4–5 баллов
	24	01 10 00	38,1	72,6		А	9	2	
		15 50 10	36,1	69,3	100	Б	9	1	
		19 53 09	36,7	71,0	240	А	9	1	
	25	00 33 08	36,4	70,0	230	Б	10	1	
28		03 16 51	37,7	72,2	115	А	13 ($m = 5,8$)	2	See text

1	2	3	4	5	6	7	8	9	10
		08 19 58	40,1	79,8		Б	10	12	
		13 36 56	37,71	69,60	2–3	б	9	2	
		19 56 12	36,4	71,2	110	Б	9	1	
	26	00 41 51	38,4	75,5	150	Б	11	11	
		10 22 23	36,6	70,9	240	Б	11	1	
		13 56 00	37,8	72,0	120	А	10	2	
		14 11 23,0	40,90	73,50		б	10	8	
		19 03 23	36,5	70,5	200	А	10	1	
		21 54 10,1	41,20	73,10	15	б	9	8	
	27	00 36 10	38,68	70,37	6	а	10	3	
		03 27 47	36,7	71,1	230	А	11	1	
		12 45 33	37,0	67,8		Б	9	1	
		15 03 26	36,7	71,1	190	А	11	1	
		16 21 57	38,74	68,51	5	б	9	4	
		20 04 57	37,2	71,4	110	А	10	2	
		21 57 00	37,6	72,5		А	10	2	
		23 40 45	38,6	73,8	110	Б	10	2	
	28	06 38 17	38,85	70,60	10	б	9	3	
		12 15 33	37,8	72,0	120	А	10	2	
		22 19 50	36,4	70,5	130	Б	9	1	
	29	04 24 01	39,4	72,9		Б	9	3	
		05 16 05	36,3	70,0	130	Б	10	1	
		05 43 38	36,5	70,1	220	А	11	1	
		06 32 06	36,3	70,7	130	Б	9	1	
		12 03 17	36,5	70,8	140	Б	10	1	
		14 25 03	37,83	69,46	10	б	10	3	
		22 25 47	37,0	68,9		А	11	1	
	30	01 09 48	36,2	71,3	100	Б	10	1	
				May					
	1	12 08 12	39,7	74,6		Б	9	11	
		12 25 33	39,6	74,3		Б	10 (M=3,6)	11	
		17 10 42	39,6	74,3		Б	10	11	
		17 35 07	39,8	77,5		Б	10	5	
		21 14 32	36,8	71,3	170	Б	9	1	
	2	04 14 00	36,5	69,8	190	А	9	1	
		08 31 58	36,5	70,2	200	Б	9	1	
		15 48 13,2	41,57	72,30	10–15	а	10	8	
	3	00 47 33	39,9	70,6		А	9	5	
		02 14 34	39,9	78,0		Б	9	5	
		02 44 00	36,2	73,6			10	2	
		04 46 26	37,9	71,9	110	А	9	2	
		04 48 45	36,5	71,3	100	Б	10	1	
		10 03 00	38,54	70,52	10–15	б	9	3	
		11 13 22	36,1	73,5			10	2	
		17 53 43,6	40,65	72,80	12	б	10	8	Серный рудник, Ош, 3 балла
		20 24 52	36,3	71,2	100	Б	9	1	
	4	09 57 50	37,7	72,2	190	Б	10	2	
		12 24 27	36,6	71,0	140	Б	11	1	
		14 34 00	38,5	72,9	80	Б	9	2	
		15 17 21	38,32	69,33	1–2	б	9	3	
		15 37 32	37,0	70,9		Б	10	1	
		17 02 57	42,5	63,9	0–5	А	9	20	
		22 40 20	41,2	79,3		Б	10	5	

1	2	3	4	5	6	7	8	9	10
	5	11 29 33	38,8	74,8		Б	11	11	
		14 38 55	36,5	71,2	140	Б	10	1	
		16 10 34	36,7	71,3	190	Б	9	1	
		16 13 59	36,3	68,1		Б	11	1	
		18 05 50	36,2	69,6	130	А	9	1	
		19 44 56	36,6	70,8	230	Б	9	1	
		21 40 52	42,5	68,8	25	А	10	10	
29	6	13 22 47	36,5	70,3	220	А	13	1	
		16 33 21	36,2	71,3	100	Б	10	1	
		17 52 32	39,6	75,4		А	9	11	
		22 13 22	39,6	67,8	15	А	9	5	
	7	03 42 13	39,4	72,3		А	9	3	
		06 14 51,9	42,90	73,57	10	а	9	7	
		12 27 54	36,7	70,8	220	Б	9	1	
		17 39 07	36,6	70,8	220	А	10	1	
30	8	11 04 00	39,37	70,98	10	а	12	5	Джиргаталь, 3 балла
		14 05 21,8	40,85	72,67	23	а	9	8	
		21 51 46	38,73	70,49	10	б	9	3	
		23 05 19	42,0	79,9		Б	9	5	
	9	02 51 56	36,1	70,5	100	Б	9	1	
		05 16 27	39,11	69,04	5	б	9	5	
	10	05 44 33	36,5	70,7	160	А	10	1	
		20 42 57	39,9	77,9		Б	9	5	
	11	01 28 23	38,4	73,8	130	Б	9	2	
		04 56 40	36,5	70,8	140	Б	9	1	
		11 38 17	39,2	71,8		А	9	3	
		21 43 25	40,8	71,2	5	А	9	8	
	12	00 09 28	44,8	80,8			9	13	
		13 29 50	36,2	69,6	120	А	10	1	
		17 38 37	39,1	72,0		Б	9	3	
		18 26 31	37,3	71,8	170	Б	9	2	
	13	00 46 02	36,6	70,2	210	Б	9	1	
		01 06 33	36,5	71,3	130	Б	9	1	
		06 17 51,3	41,07	76,95		а	10	5	
		13 08 59	36,4	69,3		Б	10	1	
		18 52 33	37,4	71,7	120	А	10	2	
		19 22 21	36,5	70,8	210	А	9	1	
		20 02 02	37,2	71,1	80	А	10	2	
	14	00 08 00	36,7	68,2		Б	10	1	
		15 42 45	36,6	70,9	220	Б	9	1	
		21 33 04	37,4	71,9	160	Б	9	2	
31	15	04 17 06	39,9	77,8	52	Б	12 ($M = 4,2$)	5	
32		18 40 32	37,3	71,6	130	А	12 ($m = 5,0$)	2	
	16	01 26 12	40,1	72,7		Б	10	5	
		04 49 42	37,3	71,5	100	А	9	2	
		08 29 11	36,3	71,4	100	Б	9	1	
		09 34 31	36,2	68,6		Б	10	1	
		14 41 05	37,4	71,9	150	А	10	2	
33	17	11 06 57	40,1	79,1		Б	12 ($M = 4,2$)	12	
		11 29 23	36,7	71,2	180	А	10	1	
	18	00 34 48	36,4	70,7	100	Б	9	1	
		20 55 21	38,67	70,65	8	а	10	3	
	19	10 43 43	39,4	72,4		Б	9	3	

1	2	3	4	5	6	7	8	9	10
34		11 06 54	36,5	71,0	110	А	12	1	
	20	00 54 49	37,7	71,8	120	Б	9	2	
		06 01 32	36,5	71,3	230	Б	10	1	
		06 37 59	36,6	71,2	190	Б	9	1	
		07 51 27	37,3	71,9	190	А	10	2	
		11 13 32	36,4	71,0	100	Б	10	1	
		18 48 29	37,2	71,7	220	Б	9	2	
		20 36 05	37,8	72,2	210	Б	9	2	
		21 16 43	36,5	71,1	220	А	9	1	
	21	01 48 20	36,9	68,0		Б	9	1	
		02 23 00	38,92	70,37	5	а	11	3	
		12 00 22	40,0	70,3	5	А	9	5	
		14 36 29	36,1	68,9		Б	9	1	
		18 44 17	39,8	77,9		Б	11	5	
	22	02 17 50,5	42,30	74,80	5	а	9	7	
		03 42 02	36,3	69,7	110	А	11	1	
		08 01 10	36,5	70,0	220	Б	10	1	
		18 14 46	36,1	70,0	80	Б	10	1	
		20 53 12	36,4	69,8	240	Б	9	1	
		23 08 30	36,0	70,3	100	Б	10	1	
	23	12 12 35	36,1	69,5	100	Б	10	1	
		17 39 48	36,6	71,0	240	А	10	1	
		22 03 15	36,6	71,2	210	Б	9	1	
		22 42 49	36,5	70,8	200	Б	9	1	
	24	00 26 24	37,5	72,2	210	А	10	2	
		22 13 54	42,9	79,8			9	6	
		22 33 09	43,0	79,6			9	7	
	25	06 59 27	36,6	71,0	210	Б	10	1	
		09 28 17	39,1	73,4		Б	9	3	
		16 44 14	36,5	70,9	150	Б	10	1	
		18 50 09	36,5	70,7	230	А	10	1	
		20 15 35	36,4	70,9	120	А	11	1	
		21 06 29	39,5	74,6		Б	9	11	
	26	13 29 35	36,4	70,7	200	А	10	1	
	27	01 34 09	42,7	78,0		Б	9	6	
		02 11 12	36,4	70,8	140	Б	9	1	
		10 37 47	37,3	71,8	130	А	10	2	
		12 36 00	39,8	78,0		Б	10 (*M* = 3,9)	5	
		12 56 34	37,0	71,2	80	А	10	2	
		17 25 15	37,2	71,6		А	9	2	
	28	02 37 08	38,2	74,3		Б	9	2	
		06 37 12	36,3	70,8	120	А	11	1	
		11 12 49	39,7	70,1	5	А	9	5	
		12 51 34	36,7	71,2	240	А	11	1	
		19 08 16	37,6	69,6		А	9	2	
	29	07 25 11	40,5	66,3	15	А	11	22	
		07 56 03	36,5	71,4	80	Б	9	1	
		23 25 13	36,1	70,9	100	А	10	1	
	30	20 39 36	36,1	70,0	110	Б	11	1	
	31	20 55 19	43,9	76,9			9	15	
		22 31 59	36,5	70,7		Б	9	1	

1	2	3	4	5	6	7	8	9	10
				June					
	1	21 19 18	36,5	70,6	190	А	10	1	
	2	10 13 54	39,5	73,7		Б	10	3	
		15 18 50	36,2	70,5	130	Б	10	1	
	3	12 16 57	37,5	72,1	210	Б	10	2	
		16 47 28	36,6	71,1	190	Б	10	1	
	4	06 37 24	38,72	68,63	10	б	9	4	
		07 38 57	37,6	71,9	200		9	2	
		10 03 51	39,0	70,5		Б	9	3	
		10 59 21	36,5	70,8	190	Б	10	1	
		14 11 30	39,4	73,8		Б	10	11	
		14 26 34	40,0	73,1	5	А	9	5	
		22 44 47,1	41,63	73,20	22	а	9	6	
	5	00 54 25	38,8	71,0		Б	9	3	
		08 59 34	36,3	69,3		Б	11	1	
		13 58 54	40,1	76,3		Б	9	5	
		18 02 59	42,4	78,2			9	6	
		23 22 00	39,05	69,42	12–13	а	9	5	
35	6	02 15 38	39,8	75,0		Б	12	11	
36		15 51 16	36,4	70,7	213	Б	13	1	
							(m=5,1)		
	8	05 48 40	36,2	70,7	130	Б	11	1	
		16 51 59	38,53	69,66	1–2	б	10	3	
		18 28 09	38,6	70,6	13	А	9	3	
		23 25 37	39,4	71,2	9	А	9	3	
	9	00 34 26	36,4	70,9	80	Б	10	1	
		20 08 11	36,5	70,0	230	Б	10	1	
	10	02 31 22	36,4	70,9	140	Б	10	1	
		04 08 45	38,46	68,79	5	б	9	4	
37		16 08 39	39,3	74,9		Б	13	11	
	10	17 32 04	36,7	71,1	180	Б	9	1	
	11	08 59 01	36,4	68,4		Б	10	1	
		16 20 40	36,5	70,9	230	А	9	1	
38		20 06 07	36,9	71,0	90	Б	12	1	
	12	00 14 16	36,7	71,1	200	А	9	1	
		02 40 11	36,8	70,5		Б	9	1	
		18 22 05	36,4	71,2	120	Б	10	1	
	13	00 25 50	40,3	77,4		Б	9	5	
		18 48 15	39,3	71,8		Б	11	3	
	14	07 45 42	38,38	69,70	2–3	б	10	3	
		07 56 56	36,3	70,5	100	Б	10	1	
		10 26 50	36,7	71,1	170	А	9	1	
		13 40 18	36,6	71,0	240	Б	9	1	
39		16 59 14	37,1	71,3	100	Б	12	2	
40		18 20 28	36,4	70,9	200	Б	12	1	
							(m=5,1)		
	15	09 03 57	36,2	70,5	130	Б	9	1	
		17 14 59	36,7	71,2	190	Б	9	1	
	16	00 16 55	39,9	77,9			9	5	
		03 32 04	36,9	71,0	220	Б	9	1	
		08 48 42	38,8	71,8		Б	10	3	
		10 34 32	38,50	69,65	5	б	9	3	
		11 59 04	37,7	72,3	210	Б	9	2	
		12 51 03	37,9	72,1	120		9	2	
		13 45 43	45,5	78,4			9	13	
		22 19 47	36,7	71,4	190	Б	10	1	

1	2	3	4	5	6	7	8	9	10
	17	00 18 32	36,5	70,2	200		9	1	
		08 02 34	38,70	70,37	25	б	10	3	
		09 09 36	37,5	70,2		А	11	2	
		15 46 00	40,6	78,4		Б	10	5	
		17 40 24	37,0	71,3	110	Б	11	2	
	18	04 10 00	36,6	70,8	160	А	9	1	
		12 53 27	44,4	80,7			9	13	
		19 52 52	37,4	72,1	220	Б	9	2	
		23 41 19	38,9	75,2		Б	10	11	
	19	04 47 08	36,6	71,1	150	Б	9	1	
		15 01 49	38,58	69,63	2–3	б	9	3	
		18 22 18	37,2	71,5	120	Б	10	2	
	20	00 11 36	40,2	74,7		Б	9	5	
		01 38 58	40,6	78,1		Б	9	5	
		12 47 10	41,0	71,8	10	А	9	8	
		16 41 44	36,5	70,6	220	А	11	1	
		19 57 53	36,4	70,3	220	Б	10	1	
	21	03 14 53	36,5	70,7	180	А	10	1	
		04 57 48	41,4	71,9	5	А	9	8	
		13 36 20	38,66	70,35	25	б	9	3	
		18 23 08	36,3	71,1		А	10	1	
	22	19 14 21	36,9	70,8		Б	10	1	
	23	17 30 51	36,7	70,2	220		9	1	
		20 02 51	38,8	72,4			9	3	
	24	08 45 37	38,38	69,67	10	б	9	3	
		09 44 07	36,5	69,8		Б	9	1	
	25	00 19 26	39,9	77,1		Б	9	5	
		06 25 24	36,8	70,8		А	11	1	
		16 28 45	37,7	72,0	200	Б	10	2	
		20 34 57	38,93	70,61	6–7	б	10	3	
	26	07 32 36	39,8	73,0		Б	10	3	
41	27	13 11 09	40,6	79,3	17	Б	13 ($M = 4,8$)	12	
		14 42 44	40,5	78,9			10	5	
		16 03 24	37,6	72,2	210	Б	9	2	
		23 45 29	40,7	79,2			10	5	
	28	11 15 49	36,3	70,4	100	Б	10	1	
		13 13 46	36,3	70,0	70	Б	9	1	
		14 29 04	38,96	69,84	15	б	9	5	
		21 36 23	36,6	71,0	230	Б	10	1	
	29	09 47 32	36,6	70,1	210	Б	10	1	
		11 25 54	37,3	71,7	140		9	2	
		13 00 03	36,2	69,3	130	Б	10	1	
		18 42 44	36,5	70,2	220	А	9	1	
		19 09 45	36,5	70,8	190		9	1	
		20 28 17	36,6	70,9	220	А	10	1	
	30	12 05 22	40,3	69,1	5	А	9	8	
		13 44 53	39,9	76,0		А	11	5	

1	2	3	4	5	6	7	8	9	10
				July					
	1	08 36 57,4	41,60	73,20		а	9	6	
		22 49 14	37,2	71,5	130	Б	9	2	
	2	01 43 38,4	42,80	75,80	5	а	9	7	
		07 48 22	36,2	69,5	100		11	1	
		12 48 20	37,4	71,9		А	11	2	Хорог, 3 балла
		13 49 57	36,9	71,3	180		9	2	
		21 18 46	36,2	70,0	80	Б	11	1	
		23 42 08	37,1	71,2	80	Б	9	1	
		23 46 17	37,6	71,8		А	10	2	
	3	01 01 04	38,72	68,62	10	б	9	4	
		02 51 47	39,9	70,6	10	А	9	5	
		07 42 21,7	41,93	72,43	15–20	б	11	9	
		09 46 21	36,0	69,6	80	Б	9	1	
		20 44 08	36,6	70,1	210	Б	9	1	
	4	05 28 29	36,6	70,6	230		9	1	
		13 25 58	39,5	73,5		Б	11	5	
		16 36 40	39,31	70,17	22	а	9	5	
		19 34 36	38,73	70,70	13	б	9	3	
		20 30 34	36,4	70,9	130	Б	10	1	
	5	06 35 28	42,8	78,3			10	7	
		11 31 58	36,8	71,1	220	Б	9	1	
		17 29 30	36,8	71,3	160	Б	9	1	
	6	02 13 50	36,6	71,2	100	Б	10	1	
		07 58 41	36,4	71,3	80	Б	9	1	
	7	06 29 45	36,1	68,1		Б	10	1	
		11 41 21	40,1	77,4	15	Б	11	5	
	8	04 26 44	36,5	70,0	160	Б	9	1	
	9	10 18 05	37,1	70,8			9	2	
	10	06 39 47	39,2	67,8		А	9	5	
		16 20 47	36,6	69,7	240	Б	10	1	
		19 11 33	39,9	77,1		Б	11	5	
	11	01 57 03	36,6	71,2	180	Б	9	1	
		02 02 30	37,2	70,5		Б	9	2	
		06 47 26	36,4	71,0	140	Б	9	1	
		17 37 16	36,0	70,6			9	1	
		20 16 55	37,8	72,1	180	Б	9	2	
		23 13 02	36,4	71,0	240	Б	11	1	
	12	01 46 18	36,6	71,2	80	Б	10	1	
		02 59 53	36,5	70,3	200	Б	10	1	
		07 10 37	37,0	71,8	180	Б	9	2	
		11 41 38	37,0	69,5		Б	11	1	
		12 09 32	39,52	71,24	29	б	9	5	
	13	00 56 43	36,7	71,1	240	Б	11	1	
		09 04 58	36,5	71,0	100	Б	10	1	
		19 55 33	36,5	70,5	200	Б	11	1	
		22 49 10	37,4	71,6	120	Б	10	2	
		23 12 56	37,6	72,2	200	Б	10	2	
	14	08 17 07	37,4	72,2	200	Б	10	2	
		22 15 01	37,0	71,6	250	Б	9	2	
	15	17 23 25	36,5	70,0	220	Б	10	1	
		19 39 48	36,5	71,0		Б	9	1	
	16	00 09 48	37,5	71,7	120	Б	10	2	
		04 52 59	37,4	71,9	160		9	2	
		07 12 06	36,8	71,2	180	Б	9	1	
		18 31 41	36,6	70,8		Б	10	1	
		22 43 10	36,5	70,8			10	1	

1	2	3	4	5	6	7	8	9	10
	17	00 26 30	38,42	69,67	12	Б	9	3	
		00 31 19	39,3	73,0		Б	11	3	
		00 55 36	38,96	70,77	11	Б	10	3	
		02 47 18	37,3	71,7	160	Б	9	2	
		06 14 02	39,8	77,3		Б	10	5	
		08 46 07	37,67	69,81	10	Б	11	2	
		14 33 59	36,4	70,9	150	Б	9	1	
	18	05 11 01	37,67	69,81	10	Б	9	2	
		15 53 16	36,3	71,2	80	Б	10	1	
		19 47 29	36,8	72,8		Б	10	2	
		19 55 56	40,5	66,7	10	Б	9	21	
		20 59 18	36,5	70,7	150	Б	9	1	
	19	00 28 18,7	40,50	73,27		б	9	5	
		04 35 06	37,3	71,8	200	Б	9	2	
		11 33 19	38,3	73,3	150	Б	9	2	
	20	12 27 18	36,1	69,2	100	Б	10	1	
	21	15 09 27	38,96	70,77	8	a	9	3	
		21 45 32	37,5	71,6	130	Б	10	2	
	22	02 27 08	36,0	70,1	100	Б	10	1	
		05 27 05	38,98	70,78	2	a	10	3	
		07 38 40	38,3	72,7		Б	9	2	
		07 39 41	38,3	72,7		Б	9	2	
		08 17 27	38,3	72,7		Б	9	2	
42		15 59 27	36,6	70,9	220	Б	12	1	
		23 49 12	38,8	74,0	80		10	11	
	23	02 01 39	37,2	71,8	170	Б	11	2	
		18 05 09	38,89	70,39	7	a	9	3	
		19 02 02	36,6	70,8	230	Б	11	1	
43		19 14 35	36,5	70,0	230	Б	12	1	
		19 45 53	36,5	70,3	180	Б	10	1	
		23 33 08	36,7	70,9	220	Б	11	1	
	24	03 58 45	37,2	71,9	210	Б	10	2	
		09 36 09	36,7	70,7			9	1	
		22 42 03	41,40	74,20		a	9	6	
	25	03 52 37	37,70	69,80	10	Б	10	2	
		04 05 46	39,0	71,3		A	9	3	
	25	21 59 00	41,4	79,3		A	10	5	
	26	04 20 39	38,96	70,78	6	a	11	3	
		08 17 19	40,0	77,6		Б	9	5	
		11 09 46	38,96	70,76	8	б	9	3	
		11 43 22	38,97	70,77	8	a	9	3	
		15 34 35	37,68	69,83	10	б	10	2	
		23 10 10	36,5	71,0	70	б	10	1	
	27	04 22 49	44,7	78,8			9	13	
		21 14 18	37,8	71,9	120	Б	9	2	
	28	06 41 11	36,7	70,8			9	1	
		14 54 13	37,6	71,6	100	Б	11	2	
	29	04 54 20	40,3	77,8			9	5	
		05 11 55	36,7	70,5	220		9	1	
44		11 27 18	38,7	73,6	80	Б	12	2	
		15 07 33	37,3	71,5	120	Б	9	2	
		17 33 34	39,8	74,8		A	10	5	
	30	01 03 36	39,8	75,2			9	5	
		04 44 54,7	41,37	71,95		б	10	8	
		10 30 43	36,6	70,6	100	Б	9	1	

1	2	3	4	5	6	7	8	9	10
	31	04 33 28	37,9	70,2		Б	9	3	
		07 20 37,3	40,60	73,35		б	9	8	
		12 27 12	36,6	70,8	210		9	1.	
					August				
	1	07 53 09	39,0	72,9		Б	10	3	
		09 11 40	38,4	73,6	140	Б	10	2	
		09 32 44	38,25	69,25	1–2	б	9	4	
		18 46 33	36,5	70,3	210	Б	10	1	
	2	11 04 01	36,5	70,7	180	Б	10	1	
		15 59 42	37,6	66,7	0	А	9	23	
	3	12 12 35	37,1	71,6	140	Б	11	2	
	4	06 19 42	37,3	71,6	100	Б	10	2	
		12 08 38	39,9	77,4		Б	9	5	
		12 36 58	36,7	71,2	200	А	11	1	
		17 42 21,7	41,07	73,50		а	9	8	
		20 09 12	36,5	70,9	230	Б	10	1	
	5	02 16 46	36,5	70,8	190	А	10	1	
		02 52 52	36,5	71,0	90	Б	9	1	
		03 30 19	39,5	73,9		Б	9	11	
		04 51 59	40,7	73,2	5	А	9	8	
45	6	01 17 55	36,5	70,1	224	Б	13	1	
							$(m = 6{,}1)$		
		04 09 38	42,5	78,8		А	9	6	
		07 05 01	40,0	71,8	30	А	11	5	
		12 35 29	37,69	69,79	2-	б	9	2	
		14 05 21	36,1	70,4	120	Б	10	1	
		16 08 48	36,5	70,7	210	Б	9	1	
		21 19 36	37,9	71,8		Б	10	2	
		23 34 17	41,0	75,3		А	9	6	
	7	01 08 17	36,5	70,9	230	Б	10	1	
		02 22 19	37,5	72,0	110		10	2	
		15 17 51	36,3	69,3	80	Б	11	1	
	8	01 56 58	36,4	71,2	90		9	1	
		06 29 02,2	42,97	76,33		а	9	7	
		15 29 50	38,82	71,13		а	9	3	
		17 22 46,3	40,10	76,50		б	9	5	
		19 49 39	40,1	76,4		Б	11	5	
		22 54 47	39,1	72,7		Б	10	3	
	9	02 59 57	39,1	73,2		Б	9	3	
		07 04 18	36,7	70,9	230	Б	10	1	
		15 16 37	40,0	77,1		Б	9	5	
	10	00 47 22	38,33	69,45	5	Б	9	3	
		10 10 06	37,3	71,7	160	Б	9	2	
		11 18 16	36;1	70,5	100	Б	9	1	
		11 42 14	38,87	70,29	5	б	9	3	
	11	01 41 18	36,6	71,1	220	Б	11	1	
46		01 43 30	36,6	71,0		Б	12	1	
		03 41 45	40,9	71,7	35	А	10	8	
		05 59 04	38,34	69,42	12	б	9	3	
		07 26 03	37,5	72,1	220	Б	11	2	
		21 51 25	37,1	71,7	150	Б	9	2	
	13	10 38 12	40,8	70,7	0–5	А	9	8	
		10 58 53	37,4	72,1	210	Б	9	2	
		12 28 34	36,1	70,0	80	Б	9	1	
		15 24 55	36,1	70,4	80	Б	10	1	
		20 15 20	39,7	76,1		Б	10	12	

IN IN 19

17 OCTOBER 1979 (FOUO) 2 OF 4

1	2	3	4	5	6	7	8	9	10
	14	06 14 43	36,6	70,7	180	Б	9	1	
		06 19 23	37,6	72,3	230	Б	10	2	
	15	07 32 43	37,5	72,1	200	Б	10	2	
		11 30 51	38,98	70,66	2	a	9	3	
47		15 09 09	36,5	70,9	200	Б	12 (m = 5,0)	1	
		17 50 47	38,41	69,66	12	б	10	3	
	16	17 43 29	36,3	68,7		Б	11	1	
		21 07 13	37,3	71,6	140	Б	9	2	
	17	10 34 34	38,2	73,3	140	Б	10	2	
	18	09 23 07	38,99	70,69	7	б	10	3	
		10 38 24	36,2	70,3	70	Б	10	1	
		20 33 31	37,4	71,7	150	Б	10	2	
	19	01 16 37	36,8	71,2	160	Б	10	1	
		02 49 36	36,4	71,1	100	Б	10	1	
		21 00 43	36,3	70,8	80	Б	9	1	
		22 15 32	37,0	70,9		Б	9	2	
	20	09 24 16	40,7	73,4		Б	11	8	
		12 58 36	42,6	79,1			9	6	
		14 48 39	36,2	71,0	70	Б	10	1	
	21	01 44 54	41,6	80,6			9	12	
		06 56 05	36,0	73,5		Б	10	1	
		12 00 58	39,4	75,2			9	11	
		14 50 24	40,5	76,9		Б	9	5	
		20 49 09	38,97	70,72	12	б	9	3	
	22	00 46 21	36,3	68,8		Б	9	1	
		01 47 57	38,2	72,9	150		10	3	
		03 26 29	41,7	71,9	20	A	9	9	
48		03 43 48	36,5	71,3	230	Б	12 (m = 5,0)	1	
		04 16 15	40,1	76,9		Б	9	5	
		10 50 55,5	41,00	73,60		a	9	6	
		11 33 35	36,8	71,0		Б	10	1	
		14 35 48	38,29	69,33	5	б	9	3	
		22 28 43,4	42,60	76,10	0	a	9	7	
	23	20 00 30,6	42,50	75,10	10	a	9	7	
	23	20 02 03,5	42,55	75,10		a	10	7	
		23 24 02	36,5	70,9	200	Б	10	1	
	24	00 08 46	40,5	77,5			10	5	
		05 33 46	39,6	72,1	10	A	10	3	
		06 45 57	39,2	72,4		Б	11	3	
		08 19 07	37,3	71,7			9	2	
		10 49 57	36,5	69,9	220	Б	10	1	
		12 08 47,8	42,90	76,30		б	9	7	
		17 22 31	38,5	71,8		Б	9	3	
		18 07 35	38,6	72,0		Б	9	3	
	25	03 41 35	36,6	69,8	150	Б	10	1	
		12 32 18	37,6	72,0	200		9	2	
		13 35 15	40,1	76,7		Б	9	5	
		17 51 08,7	42,97	78,20	10	a	10	7	
		19 46 17	37,3	69,8		Б	9	2	
		23 34 26	36,5	71,2	100	Б	10	1	
	26	06 51 35	37,5	71,7	170	Б	9	2	
		11 24 58	40,8	77,9		Б	9	5	
		15 32 33	39,3	71,8		Б	10	3	
		16 26 24	36,6	71,2	160		9	1	
		23 34 17	37,5	72,0	160		9	2	

1	2	3	4	5	6	7	8	9	10
	27	07 25 49	39,0	72,7		Б	10	3	
		20 30 35	36,6	70,2	210	Б	10	1	
		23 07 12	36,1	71,0	80	Б	10	1	
		23 45 11	39,4	74,2		Б	9	11	
	28	07 35 25	40,8	77,5	5	А	9	8	
		08 45 04	36,5	70,7	200	Б	11	1	
		16 14 18	37,4	70,0		А	10	2	
		20 45 23	39,1	71,5		А	11	3	
	29	09 41 28	37,3	71,7	160	Б	10	2	
		17 27 04	40,2	76,8		Б	9	5	
		18 19 09,9	42,60	75,10	10–15	а	10	7	Фрунзе, 3 балла
	30	01 27 27	36,0	73,3			10	2	
		05 33 35	36,7	70,9	230		10	1	
		12 26 38	40,1	75,8		Б	10	5	
		21 57 48	36,5	70,9	140	Б	10	1	
	31	00 24 04	36,5	71,3	80	Б	11	1	
		09 28 20	36,5	71,3	100	Б	11	1	
		21 13 49	37,62	69,60	10	б	9	2	
		21 57 33	37,65	69,60	10	б	10	2	
					September				
49	1	12 32 32,2	42,70	75,30	5–10	а	12 (M = 4,6)	7	
		18 11 10	38,7	74,0	150		10	11	
		18 44 00	36,7	71,3	80	Б	10	1	
		21 35 17,2	42,60	75,05	5	а	9	7	
	2	00 05 17	36,4	70,2	200	Б	10	1	
		11 55 17	44,1	80,9			10	13	
		13 36 39	38,66	70,01	10	б	9	3	
		14 58 21	36,6	71,1	200	Б	11	1	
50	3	17 22 13	36,6	70,9	210	Б	12	1	
		19 27 04	40,5	77,2		Б	9	5	
		22 58 14	40,5	77,4		Б.	9	5	
	4	00 02 25	36,5	71,2	80	Б	11	1	
		01 52 54	37,7	–72,9		Б	10	2	
		11 42 24	41,0	69,5	0	А	9	9	
		14 11 22	36,3	71,0		Б	10	1	
	5	00 32 47	36,6	70,9	200	Б	11	1	
		06 55 49	36,9	71,2	100		10	1	
		15 32 49	36,7	71,2	80		9	1	
		20 29 03	36,5	70,8	120	А	10	1	
	6	01 30 34	36,1	70,9	100	Б	10	1	
		06 03 35	36,7	72,3	230		10	1	
	7	16 01 28	38,61	70,66	2	а	10	3	
		16 25 30	37,0	71,7	150	Б	9	2	
	8	09 33 53	40,0	69,8	25	А	10	5	
	9	01 22 32	36,4	70,8	80	Б	10	1	
		19 05 05	36,4	70,6	200	Б	9	1	
51	11	14 28 32	39,3	72,5		А	12	3	
		16 20 35	36,6	71,0	240	Б	10	1	
		22 28 11	38,69	69,92	30	б	9	3	
	12	03 10 21	36,5	70,5	210	Б	10	1	
		23 57 27	37,2	71,5	120	А	11	2	
52	13	06 40 32	39,1	70,5		Б	12	3	
		08 12 34	40,2	77,6		Б	9	5	
		10 38 12	40,8	70,7	0–5	А	9	8	

1	2	3	4	5	6	7	8	9	10
	14	02 00 04	39,10	71,16	13	б	9	3	
53		11 29 47	38,5	70,2	5	Б	12 (*M* = 4,6)	3	
		12 30 05	38,41	70,41	12	б	9	3	
		12 32 59	38,42	70,37	7	б	9	3	
		15 11 11	38,4	70,5		Б	11	3	
		16 46 23	37,0	68,0			9	1	
		20 13 09	38,3	70,5		Б	11	3	
	15	01 02 33	38,43	70,45	23	б	9	3	
		01 51 50	36,8	71,2	190	Б	9	1	
		05 23 00	37,4	72,1		Б	10	2	
54		14 16 12	36,5	70,6	200	Б	12	1	
		17 53 07	38,3	73,1	80	Б	10	2	
		21 45 39	38,62	70,48	15	б	10	3	
	16	02 49 11	38,3	70,5		Б	9	3	
		06 33 19	38,43	70,45	23	б	9	3	
		07 39 15	36,6	69,3		Б	10	1	
		09 50 33	36,5	69,4		Б	10	1	
		13 53 29	39,5	74,1		А	9	11	
		15 48 40	36,4	71,0	100	А	10	1	
		16 59 02	36,4	70,9		Б	10	1	
		17 53 08	38,42	70,38	2	б	9	3	
		18 08 47	36,5	71,2	230	А	11	1	
		19 59 24	37,5	72,2	210	Б	9	2	
		20 42 47	39,3	72,5		Б	9	3	
	17	01 02 12	36,6	71,0	100	А	9	1	
		03 16 17	37,7	72,0	140	Б	10	2	
		03 22 23	38,89	70,49	5	б	9	3	
		04 13 10	40,1	77,5		Б	10	5	
		04 32 10	36,4	71,2	240	Б	10	1	
		06 19 13	38,5	75,0	150		10	11	
		10 24 59	36,0	70,3	80	Б	11	1	
		20 54 08	38,43	70,45	23	б	10	3	
	18	02 02 40	36,2	70,6	80	Б	10	1	
		16 23 13	36,6	70,9	150	А	9,[illegible]	1	
	19	11 35 53,6	41,80	72,43		а	10	9	
		11 52 32	37,9	65,8			9	22	
		19 33 56	38,43	70,43	25	б	10	3	
		22 42 00	36,6	70,5	200	Б	10	1	
	20	07 59 36	37,97	69,29	5	б	10	3	
		09 24 13	40,6	73,5	15	Б	11	6	
		15 43 43	37,4	72,2	220	А	10	2	
		18 17 00	36,0	69,0	80	Б	10	1	
	21	23 12 59	36,6	69,3		Б	9	1	
	22	03 26 29	41,7	71,9	20	А	9	9	
		03 59 30	38,35	68,25	2	б	9	4	
		06 49 27	44,6	78,3			9	13	
55		11 36 00	36,1	70,4	97	Б	12 (*M* = 5,2)	1	
		22 35 35	36,3	70,8	130	Б	10	1	
	23	05 55 21	38,6	72,7			9	3	
		05 55 37	38,9	70,5			9	3	
		08 50 42	38,44	70,41	1–2	б	9	3	
		21 39 15	38,94	70,59	5	а	9	3	

1	2	3	4	5	6	7	8	9	10
	24	01 27 37	36,9	68,5		Б	9	1	
		05 33 46	39,6	72,1	10	А	10	3	
		08 19 08	37,4	71,3	130	Б	9	2	
		09 36 14	40,7	79,3			10	12	
		17 38 19	39,0	72,0		А	9	3	
56	25	13 00 18	36,5	70,9	210	А	13	1	
							(m = 5,1)		
		17 43 53	41,4	79,0			9	5	
57		18 39 00	36,8	71,3	90	А	13	1	
	26	02 37 13	36,4	71,0	100		9	1	
		11 24 07	36,6	70,9	180	А	10	1	
		13 39 23	38,70	69,92	25	б	9	3	
		19 20 23	36,6	69,1	130	Б	9	1	
	27	04 17 09	38,28	69,38	1–2	а	9	3	
		06 55 22	39,19	70,40	17	а	10	5	
		09 36 54	37,72	69,85	5	б	10	2	
		17 26 27	36,4	70,9	90	А	10	1	
	28	00 57 25	37,1	71,8	200	Б	10	2	
		03 24 04	37,6	71,6	100	Б	9	2	
		05 19 41	37,2	71,5	130	Б	11	2	
		09 16 24	36,7	70,9	230	А	11	1	
		13 14 12	41,0	72,2	5	А	9	8	
	29	02 47 57	36,3	71,7			9	1	
		18 04 18	36,6	70,6	220		9	1	
		20 36 14	36,3	70,3	150	А	10	1	
		21 30 55	36,5	70,8	210	Б	10	1	
		21 31 48	36,4	71,3	160		10	1	
	30	00 40 06	36,3	71,0	120	Б	9	1	
		01 39 44	36,6	69,7		А	9	1	
		05 52 51	36,5	70,4	160	А	11	1	
		09 10 28	36,5	71,0	110	Б	10	1	
		18 46 40	38,4	75,0	240	Б	10	11	
					October				
	1	08 54 52	40,0	77,3		Б	10	5	
		11 46 15	43,5	78,7			9	7	
		19 23 18	38,39	70,42	2	а	9	3	
58	2	12 17 02	37,0	71,3	90	Б	12	2	
		16 03 31	36,0	73,5		Б	11	2	
		19 59 17	36,5	70,8	190	Б	10	1	
		23 46 46	36,6	70,8	240	Б	10	1	
	3	12 39 37	39,23	70,83	8	а	11	3	
		14 38 36	39,0	71,0		Б	9	3	
		15 12 26	36,6	70,9	220	Б	10	1	
		16 29 39	36,5	71,1	80	А	9	1	
		20 09 11	36,9	69,5		Б	9	1	
	4	03 37 32	36,6	69,7		Б	10	1	
		04 05 29	36,5	69,8	240	Б	11	1	
		12 12 40	37,8	65,9		Б	9	22	
		18 06 25	36,9	72,0	80	Б	10	1	
		22 14 55,2	42,20	75,99	15	а	9	6	
	5	02 01 28	36,2	71,0	100	А	9	1	
		04 16 50	36,2	69,1		Б	9	1	
		07 56 45	36,0	70,5	70	Б	10	1	
		11 17 31	36,4	68,6			11	1	

1	2	3	4	5	6	7	8	9	10
59		20 23 16	36,6	71,0	220	А	12	1	
	6	01 16 55	38,6	73,2	130	Б	10	2	
		10 34 15	36,4	69,8	130	Б	10	1	
		12 06 56	36,5	70,2	240	Б	11	1	
		15 05 12	38,5	73,2	80	Б	9	2	
		21 44 31	36,5	70,2	230	Б	10	1	
		23 23 15	37,4	71,7	90	Б	9	2	
	7	02 42 55	36,7	70,9	220	Б	9	1	
	8	05 00 28	36,1	70,4	100	Б	11	1	
		15 21 00	36,5	70,7	230	Б	10	1	
	9	04 02 16	38,73	68,32	10	а	9	4	
		04 07 01	37,1	71,1	80	Б	10	2	
		13 29 11	36,6	70,6	220	Б	11	1	
		15 24 14	38,6	73,3		Б	10	2	
		22 28 19	36.6	70,8	230	Б	10	1	
	10	02 48 28	37.71	69,83	5	б	9	2	
		14 05 23	37,4	71,5	100	Б	9	2	
		15 05 44	37,5	72,2	200	Б	9	2	
		16 00 27	37,1	71,9	160	Б	9	2	
		18 36 25	39,4	71,6		Б	10	3	
		23 30 57	37.7	72,0	130		9	2	
	11	08 12 43	36,4	69,9	150	Б	9	1	
		11 29 53	37,4	71,8	170	А	10	2	
	12	02 30 16	36,3	70.5		Б	9	1	
60		02 54 06	37,7	71,9	0–5	Б	13	2	See text
							(M = 5,2)		
		03 15 13	37.4	71.8		А	10	2	
		07 38 12	38,97	70,61	1–2	а	9	3	
		08 02 00	39.4	76.7		Б	9	12	
		14 01 27	39,5	75.3		Б	9	11	
		20 18 14	36,5	70,3	200	Б	10	1	
	13	00 17 35	36,4	70,5	230	А	10	1	
		05 50 22	36,7	70,7	220	Б	9	1	
		06 01 40	40.5	77,6			9	5	
		07 49 55	37.7	71,6		А	9	2	
		08 50 57	37,5	71,8		Б	9	2	
		11 18 02	39,9	69,9		Б	9	5	
		15 41 28	38,0	72,9		Б	10	2	
	13	16 46 30	36,6	71,1	160		9	1	
		21 40 27	36,8	71.1	80		9	1	
		22 48 22	37,6	71,9			9	2	
	14	00 26 31	37,2	70,3	100		9	3	
		23 40 17	36,6	70,8	210	А	10	1	
	15	03 32 04	36,8	71,0	80		9	1	
		15 56 14	37,8	72,4	170	Б	9	2	
	16	09 38 19	36,0	69,0	130		10	1	
		20 00 53	36,3	71,0	80		9	1	See text
61	17	03 16 18	36.4	71,1	220	А	14	1	
							(m = 6,0)		
		05 59 00	37,4	71,2	80	Б	10	2	
		07 21 00	36,5	69,4		Б	9	1	
		07 53 13	37,7	71,9	150	Б	10	2	
		15 04 56	36,5	70,6	210	Б	10	1	
		19 43 34	36,6	71,2	180	Б	11	1	
		21 09 00	36,8	71,1	180	Б	9	1	
	18	04 10 34	36,6	71,3	200	Б	9	1	
		16 34 16	36,6	71,0	100		9	1	

1	2	3	4	5	6	7	8	9	10
62		23 44 52	36,7	71,2	180	А	12	1	
	19	02 53 29	39,6	74,9		Б	9	11	
		03 10 38	39,6	77,3		Б	9	12	
		06 25 08	36,5	71,1	210	А	11	1	
		06 52 58	36,1	70,6	70		9	1	
		11 57 37	37,0	69,8		Б	9	1	
		12 00 22	37,0	70,0		А	10	1	
		19 12 32	37,7	71,8		А	9	2	
		20 13 13	37,8	72,3	170	А	9	2	
	21	03 16 20	36,1	69,4	100	Б	10	1	
		03 49 30	36,5	70,9	100	Б	9	1	
		09 12 11	36,6	69,7	150	Б	9	1	
		09 54 32	36,6	70,4	160	Б	9	1	
		15 41 53	36,6	70,9	200	Б	9	1	
		16 07 17	36,5	71,0	100	Б	9	1	
	22	09 23 02	36,5	71,1	140	Б	9	1	
		18 45 09	36,6	70,7	230	Б	10	1	
		19 32 46	37,0	71,0	70	Б	9	1	
	23	02 12 45	36,6	70,9	220	А	10	1	
		05 36 50	36,5	70,1	150	Б	9	1	
		11 48 21	38,4	67,6	0	А	9	4	
		20 57 46	36,6	70,7		Б	9	1	
		21 01 46	39,7	74,3		А	9	11	
	24	04 35 35	38,29	69,38	1–2	б	9	3	
63		04 51 31	41,6	79,6		А	12	5	
		10 36 04	41,6	79,3			9	5	
		12 12 35	38.29	69.37	1–2	б	9	3	
		12 51 51	37,5	71,9	150	Б	9	2	
		22 28 02	36,5	70,1	220	Б	10	1	
	25	10 34 42	36,5	70,8	130	Б	9	1	
		10 49 36	36,5	70,8	230	Б	10	1	
		17 00 59	42,7	79,2		Б	10	6	
	26	13 08 40	37,3	71,5	110	Б	11	2	
		16 57 18	36,4	71,0	80	Б	10	1	
		21 50 34	37,1	71,5	130	Б	9	2	
	27	08 04 30	36,4	70,2	180		9	1	
		10 07 10	41,0	79,2		Б	11	5	
		15 37 53	36,4	70,8	130	Б	10	1	
		18 09 36	40,8	79,1		Б	9	5	
	28	13 43 34	36,2	70,8	70	Б	11	1	
		14 44 27	39,2	67,3		Б	10	5	
		20 24 32	38,1	73,3		Б	10	2	
	29	16 47 29	39,1	70,3		А	9	3	
	30	00 39 58,9	40,70	73,10		б	9	8	
		12 38 49	36,3	70,0	200		9	1	
		12 46 18	38,6	73,7	130	Б	10	2	
		14 49 30	38,0	72,9		Б	9	2	
		14 59 43	38,40	69,66	1–2	б	9	3	
		18 40 05	36,4	70,8	180	Б	9	1	
	31	07 18 18	36,0	69,4	80	Б	10	1	
		18 12 55	39,1	70,9		А	9	3	
		22 15 39	38,25	69,26	1–2	б	10	4	
		23 44 31	38,1	73,9	160	Б	9	2	

1	2	3	4	5	6	7	8	9	10
					November				
	1	10 56 38	40,5	70,9			9	8	
		11 35 10	39,03	70,96	9	а	10	3	
		13 16 44	38,29	69,33	1–2	б	9	3	
	2	00 45 31	36,9	71,1	70	Б	9	1	
		09 02 37	39,2	67,2		Б	10	5	
		12 50 18	36,8	71,0	230	Б	10	1	
		17 34 29	36,9	70,6			9	1	
64		22 20 59	36,2	69,6	135	Б	12 (*m* = 5)	1	
	3	07 03 34	36,3	70,9	80	Б	9	1	
	4	04 05 15	36,6	71,0	250		9	1	
	5	04 25 56	40,0	73,0	5	Б	10	5	
		05 02 08	37,75	69,72	2	б	9	2	
		10 16 00	38,5	73,1	90	А	10	2	
		19 34 53	36,5	71,0	230	А	10	1	
		22 05 35	38,38	70,43	1–2	б	9	3	
	6	03 45 24	38,43	70,43	25	б	10	3	
		16 49 27	37,7	72,0	130	А	10	2	
	7	00 35 03,8	41,33	72,63		б	10	8	Ак-Терек Гава, 4 балла
		09 45 19	37,75	69,86	5	б	10	2	
		11 17 38	39,7	67,9	5	А	9	5	
		12 55 08	36,4	74,5			10	2	
		15 42 12	36,5	71,3	80	Б	10	1	
		19 58 30	38,64	68,25	5	б	9	4	
		00 28 39	38,53	70,54	4	а	11	3	
		14 24 58	37,1	71,6	130	Б	9	2	
		15 04 12	37,6	71,8	120	А	10	2	
		15 58 04	37,89	70,28	1–2	б	9	3	
		17 41 35	36,2	70,0			9	1	
		18 23 17	36,4	70,7	200	Б	11	1	
		19 27 17	40,7	74,4		А	10	5	
		21 58 54	36,6	70,8	220	Б	9	1	
		22 05 33	37,0	71,3	210	Б	9	2	
		22 06 49	38,1	73,0	150	А	9	2	
	9	05 34 22	42,2	79,6			9	5	
		08 23 27	36,6	71,1	100	Б	9	1	
		13 39 06	36,2	69,9	110	Б	10	1	
	9	15 18 52	36,9	71,5	190	Б	9	1	
	10	07 02 54	36,5	70,5	150	Б	10	1	
		18 41 36	36,4	71,1	80	Б	9	1	
	11	02 24 56	36,5	70,8	180	Б	10	1	
		09 15 05	37,75	69,77	5	б	9	2	
		13 30 32	37,0	71,8	250	А	10	2	
		14 27 32	36,6	71,1	220	Б	1'	1	
	12	00 26 32	39,5	73,7		Б	1ᴗ	3	
		12 46 02	38,83	70,17	22	а	9	3	
		15 52 33	37,0	71,3	110	Б	10	2	
		16 53 48	36,3	70,8	100	Б	10	1	
		18 41 31	36,6	70,1	220	Б	9	1	
	13	07 56 18	36,6	70,5	200	Б	10	1	
65		11 06 18	39,01	70,85	8	б	12	3	
		11 56 26	36,4	70,6	150	Б	10	1	
		18 34 03	37,7	71,8	100	Б	9	2	
		19 33 15	40,0	77,0		Б	9	5	

1	2	3	4	5	6	7	8	9	10
	14	02 46 25	38,5	70,6		Б	9	3	
		04 57 20	36,4	71,1	240	Б	10	1	
		05 08 13	36,5	71,2	120	Б	9	1	
		07 27 09	36,7	70,1	200	Б	10	1	
		10 54 18	36,8	71,2	130	Б	9	1	
		15 49 16	41,0	78,5		А	11	5	
	15	00 22 09	36,5	69,6	110	Б	11	1	
		01 40 39	36,7	70,8	200	Б	9	1	
		07 30 06	36,5	70,0	220	Б	9	1	
		09 26 37	36,8	69,4		Б	9	1	
		19 25 42	36,5	70,4	140	Б	9	1	
66	16	03 37 01	37,4	72,1	200	Б	12 ($m = 5,0$)	2	
		12 09 09	36,6	70,3	210	Б	10	1	
		15 23 33	44,8	78,5			9	13	
		19 01 31	36,4	71,2	100	Б	9	1	
	17	04 35 45	36,3	69,7	100	Б	10	1	
		06 03 59	39,6	75,2		Б	10	11	
		11 53 54	39,6	71,9		Б	9	5	
		13 57 11	36,6	70,8	200	Б	9	1	
		15 37 03	39,4	71,9	10	А	10	3	
		18 47 35	39,5	73,8		А	11	3	
		23 05 40	39,1	73,2		Б	9	3	
	18	05 25 39	36,7	70,7	250		9	1	
		07 38 48	36,8	70,8	250	Б	9	1	
		08 46 12	38,53	69,94	1–2	б	9	3	
		10 18 16	36,3	69,5	150	Б	10	1	
67		16 28 46	40,2	76,7		А	12	5	
		19 44 41	40,2	76,7		Б	10	5	
		21 37 53	36,6	69,5	180	Б	9	1	
	19	09 09 33	36,4	69,9	220	Б	10	1	
		23 39 59	37,6	71,9	140		9	2	
	20	00 28 54,2	42,13	74,83		а	9	6	
		01 24 07	36,4	70,3	180	Б	10	1	
		06 56 06	36,8	71,1	200	Б	9	1	
		16 57 53	37,1	70,8		Б	9	2	
		17 24 34	36,4	71,1	100	Б	10	1	
		21 19 38	36,5	71,0	220	Б	10	1	
		21 30 18	37,0	71,6	150	Б	11	2	
		21 39 59	38,08	69,77	2	б	9	3	
		23 32 49	37,4	72,0	150		10	2	
	21	04 11 09	36,4	70,2	220	Б	11	1	
		04 58 02	37,3	71,7	150	Б	10	2	
		09 04 24	36,5	71,2	100	Б	10	1	
		17 31 09	36,4	71,2	130	Б	9	1	
		18 40 13	36,7	71,3	180	Б	9	1	
	22	06 06 26	40,8	78,0		Б	11	5	
		10 20 45	36,3	69,4	80	Б	9	1	
		15 11 04	44,9	78,3			9	13	
		21 27 19	37,95	70,29	10	б	10	2	
68	23	15 37 32	36,9	70,1	30	Б	12	1	
	24	00 47 57	39,6	78,3			9	12	
		05 44 33	39,0	76,7		Б	10	12	
		05 58 57	38,45	68,93	12	б	10	4	
		09 56 00	38,71	70,71	11	б	10	3	
		10 04 31	40,4	76,9		Б	10	5	

1	2	3	4	5	6	7	8	9	10
		14 05 38,7	42,00	72,37		а	9	9	
		15 41 15	39,0	76,3		Б	10	12	
	25	02 05 06	40,6	77,2		Б	11	5	
		02 40 56	40,6	77,1		Б	9	5	
		07 06 00	37,4	71,8	150	А	10	2	
		08 12 30	38,19	69,80	10	б	9	3	
		17 13 40	36,4	71,1	100	Б	10	1	
		21 57 58	36,6	70,8	250	Б	9	1	
	26	18 33 17	39,19	70,30	5	б	9	5	
		18 58 49	40,5	76,9		А	10	12	
	27	00 25 58	38,42	70,48	9	б	9	3	
		06 13 20	36,7	71,0	180	Б	9	1	
		08 20 59	39,5	73,5		Б	9	3	
		15 26 59	37,2	71,7	150	А	10	2	
		20 22 32,5	39,90	73,80		а	10	5	
	28	08 20 41	36,8	71,1	70	Б	11	1	
		19 58 55	38,0	72,5	140	А	11	2	
		22 41 15	37,6	72,1	200	Б	9	2	
		23 08 32	36,4	69,8	150	Б	9	1	
	29	15 40 39	36,4	71,0		Б	9	1	
	30	15 51 38	36,5	71,0	240	А	11	1	
					December				
	1	04 43 22	40,6	77,7		Б	10	5	
		06 40 10	36,3	70,9	80	Б	10	1	
		10 29 53	37,7	73,2			9	2	
		18 10 48	37,2	71,7	180	Б	10	2	
	2	02 29 21	38,4	73,3	100		9	2	
		03 50 09	37,3	71,6	100	Б	9	2	
		04 18 52	39,5	72,2		Б	9	11	
		07 24 52,3	40,34	72,40	12	а	10	5	
		12 02 45	36,4	71,0	80	А	11	1	
		13 39 33	38,4	73,3	100	Б	9	2	
	3	01 30 21	36,8	70,1	220	Б	9	1	
		02 29 21	39,2	67,3	0–5	А	9	5	
		10 41 17	38,58	69,75	2	б	9	3	
		11 41 57	37,1	71,7	170	Б	9	2	
		18 53 33	38,58	69,75	2	б	9	3	
		18 55 36	40,5	77,3		Б	10	5	
	3	19 04 45	37,1	71,9	200	Б	9	2	
		20 56 50	37,5	72,1	140	Б	9	2	
		23 50 35	36,6	70,7	220	Б	9	1	
	4	04 30 24	36,6	70,8	200	Б	9	1	
		04 46 07	39,30	73,50		б	[illegible]	3	
		19 10 18	36,6	70,9	250	Б	9	1	
		22 22 31	36,4	71,1	100		9	1	
	5	06 02 56	38,72	70,12	7	б	10	3	
		13 53 43	36,5	71,0	80	Б	11	1	
		20 16 01	37,3	71,9	150	Б	11	2	
	6	02 57 43	38,7	70,1	2	А	10	3	
		03 53 17	36,5	70,1	200	Б	9	1	
		07 05 20	36,3	71,1	120	Б	10	1	
		07 32 41	36,8	72,1		Б	10	1	
		16 31 47	36,6	71,3	180	Б	9	1	
		16 54 37	37,2	71,5	120	Б	9	1	

1	2	3	4	5	6	7	8	9	10
	7	02 40 38	38,95	70,78	5	Б	10	3	
		05 25 16	38,8	74,2		Б	9	11	
		07 33 28	37,5	74,1		Б	9	2	
		14 28 48	40,0	77,6		Б	9	5	
		21 13 50	40,5	78,5			9	12	
		21 29 31	38,4	73,8	140	Б	10	2	
	8	02 14 33	39,1	71,7		А	11	3	
		02 31 11	39,0	71,6		Б	10	3	
		13 40 17	40,4	71,8	5	А	9	8	
69	8	15 19 37	37,1	71,4	110	Б	12	2	
		15 25 18	43,5	63,1	5	А	10	20	
		21 06 20	37,2	71,5	100	Б	9	2	
	9	02 49 05	36,4	70,9	150	Б	10	1	
		04 36 41	37,6	72,2	180	Б	9	2	
	10	18 28 18	36,5	70,4	80	Б	9	1	
		22 28 36	36,6	71,0	100	Б	9	1	
	11	05 53 35	36,6	70,8	230	А	10	1	
		12 11 16	39,8	71,9		Б	9	5	
		15 53 57	36,4	70,0	230	А	10	1	
		17 29 30	37,5	72,0	200	А	10	2	
		20 44 15	36,7	71,0	250	Б	9	1	
	12	06 27 18	36,6	70,3	230	Б	10	1	
		08 30 27	36,8	70,9	80	Б	9	1	
		09 16 46	38,9	71,0	26	А	9	3	
		11 35 57	39,8	71,5	5	А	9	5	
		22 40 50	36,3	71.1	150	А	11 ($M=5,0$)	1	
	13	01 06 45	36,6	70,9	200	Б	11	1	
		12 29 13	36,4	71,0	110	Б	9	1	
	14	01 49 05	36,4	71,0	100	Б	9	1	
		02 13 47	36,7	71,4	100	Б	10	1	
		07 36 10	36,4	70,5	100	Б	10	1	
		09 35 22	40,4	71,5	5	А	9	8	
	15	00 17 08	37,4	70,1		Б	9	2	
		05 16 37	37,4	69,9		Б	10	2	
	16	01 06 38	38,1	67,3		Б	9	4	
		03 09 22	37,2	71,4	110	Б	11	2	
		12 30 23	40,8	73,1		Б	9	8	
		15 32 34	36,4	71,2	80	Б	10	1	
	17	09 21 25	36,6	71,1	200	Б	10	1	
70		10 10 32	36.0	70,2	80	Б	12	1	
	18	02 05 43	36,0	69,3	100	Б	10	1	
		11 06 54	36,8	71,2	190	Б	10	1	
		15 30 50	38,1	72.5	150	Б	10	2	
	19	01 59 20	39,1	73,5		Б	10	3	
71		07 18 05	39,6	77,7		Б	12	12	
		13 19 28	39,0	72,6		Б	9	3	
		15 34 37	36,7	70.8	230	Б	10	1	
		18 56 44	43,8	76,9		Б	9	15	
		19 33 04	37,5	73,8		Б	9	2	
		23 38 52	36,6	70.0	220	Б	9	1	
	20	15 27 14	37,1	71,0		Б	10	2	
	21	01 30 51	40,8	71,1	5	А	10	9	Уйгурсай, 4 балла; Наманган, 3–4 балла

1	2	3	4	5	6	7	8	9	10
		19 03 23	39,03	69,88	20	а	9	5	
	22	13 11 30	38,1	72,8	130	Б	9	2	
		17 39 24	38,99	70,70	7	а	9	3	
	23	08 43 44	36,6	70,8	170	А	9	1	
		15 40 51	38,86	70,33	17	а	9	3	
		20 47 49,0	43,63	74,50	10	а	11	16	
		22 01 35	39,3	73,4		А	10	3	
	24	13 30 39	37,4	69,7		А	10	2	
		15 15 45	37,3	71,8	180	А	10	2	
		23 04 12	39,22	70,66	12	а	11	3	
	25	04 11 27	36,4	71,1			10	1	
		14 43 26	37,3	71,4	100	Б	10	2	
	26	06 43 21	38,30	69,35	1–2	а	10	4	
		10 07 54	44,3	77,6		А	9	13	
		10 39 01	38,5	75,5	150	Б	11	11	
		11 37 28	38,31	69,38	1–2	б	9	3	
	27	18 24 56	39,21	71,67	7	а	9	3	
	28	01 03 44	37,7	71,7		Б	9	2	
		12 03 08	36,4	71,3	90	Б	10	1	
	30	01 55 50	37,1	71,8	240	Б	9	2	
		13 25 07	40,5	72,2	25	А	11	8	Тулейксн, Андижан, 3 балла
		16 39 15	37,1	71,1	90	Б	10	2	
		22 08 28	37,1	71,8	230	Б	9	2	
	31	03 40 01	37,9	67,4	5	А	10	4	
		07 07 45	39,1	74,2	20	Б	9	11	
		11 15 12	36,8	70,7		Б	10	1	
		12 41 50	37,5	69,8		А	10	2	
		16 25 51	36,5	71,0		Б	10	1	
		17 59 39	37,2	71,6	130	Б	11	2	

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KULYAB EARTHQUAKE ON 2 APRIL 1973

A. A. Kon'kov

The earthquake on 2 April occurred at 02:43 (08:43 local time). The parameters of this earthquake, according to the data from various seismological institutions and macroseismic studies, are given in Table 1.

Table 1. Parameters of Kulyab Earthquake

	(1) Момент возникновения, час, мин, сек	Координаты эпицентра (2)		Глубина очага, км (3)	M	K_{Δ}	I_0, баллы (4)
		φ°N	λ°E				
ИФЗ (5)	ip 02 43 25	37,7	69,7	253	5,2	–	–
(6) по макросейсмическим данным	02 43	37°51′	69°53′	12	–	–	6–7
ТИССС (7)	02 43 21	37,7	69,8	з.к.	–	12,9	–
(8) Сейсм. ст. Куляб	02 43 20,5	37°50′	69°51′	–	5,3	13,2	–

Key:

1. Moment of occurrence, hrs, mins, secs.
2. Coordinates of epicenter
3. Depth of focus, in km
4. I_0, points
5. Institute of Physics of the Earth
6. According to macroseismic data
7. Institute of Earthquakeproof Construction and Seismology of the Tadzhik SSR Academy of Sciences
8. Seismological station at Kulyab

The earthquake on 2 April was preceded by five foreshocks, recorded on 1 April, two of which had $K \geqslant 9$. The earthquake was accompanied by numerous repeated jolts (over 380), of which the strongest were on 2 April at 04:04 (I=4-5, M=4.2, K=11.6), on 3 April at 22:19 (I=5, M=4.5, K=11.6) and on 10 April at 21:27 (M=4.3, K=11.5) with an intensity of 5 points.

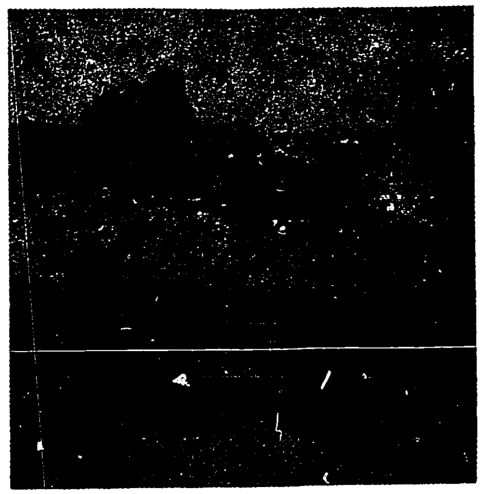

Figure 1. Sary-Chashma. Collapse of Chimney on Boarding School Building

The magnitude of the earthquake was estimated according to the MSK-64 scale and a scale with additional criteria for Tadzhikistan [1], according to which the intensity of the earthquake corresponded to 6-7 points.

The territory of the region encompassed by the earthquake is located within the limits of the Yakhsuyskiy depression, which was formed by Middle Cenozoic structures with a thickness of 10-12 km. The Middle Cenozoic deposits of the Yakhsuyskiy depression were intensively dislocated by Alpine movements into a series of folds (anticlinal and synclinal) of an almost meridional strike. The main ones of them are: to the west--the Kulyabskiy anticline, and to the east--the Turkaninksko-Dzhilginskiy and Muminabadsko-Shroabadskiy syncline.

The Kulyabskiy anticline runs from the Pyandzh River to Kulyab and further to the north. The curved part and western wing of the anticline are partially eroded by the Yakhsu River. The nucleus of the Kulyabskiy anticline is represented by Neogenic deposits with steep, up to 70-80°, eastern dip of the strata. The western wing slopes more gently and is broken by the diapiric domes of Khodzyamumin and Khodzhasartis. The possibility is not ruled out that their formation is connected with the existence here of an assumed longitudinal fault, typical of the anticlinal structures of the Tadzhik depression.

The Turkaninsko-Dzhilginskiy syncline is formed by Neogenic deposits. In the core of the syncline almost horizontally, the upper Neogenic formations occur, with the western limb being steeper than the eastern.

Table 2. Macroseismic Data on the Earthquake on 2 April

No, in order	Location	Δ, km
	6-7 points	
1	Balkhovi [1]	3.5
2	Kulyab	10
3	Sary-Chashma	11
	6 points	
4	Chagam-miyena	2.8
5	Chagam-poyen	4
6	Balkhovi [2]	4.2
7	Tu-To	5.8
8	Naubulak	6
9	Bogikhabib	8.2
10	Sangpar	11
11	Beshtegerman	12
12	Siyeb	12
13	Shakarkhon	12.4
14	Dzhangalbashi	13.4
15	Odinaboi	14
	5-6 points	
16	Nazarboi	6
17	Mumirak	6.5
18	Didarozak	6.8
19	Tebolyay	7.5
20	Zarbdor	9.8
21	Sovkhoz imeni Nazarov	10
22	Lagman	11.6
23	Pereval	11.8
24	Kolkhoz imeni Shatalov	12
25	Boginav	14
26	Choktemur	14.2
27	Tugarak	17.5
28	Mishkaron	17.6
29	Fayzabad	19
30	Imeni Vose	20.4
31	Irbat	20.8
32	Sol'zavod No 1	21.8
	5 points	
33	Garabdara	9
34	Kolkhoz imeni Zhdanov	11.4
35	Chordara	14
36	Zakirabad	14.6
37	Tu-Tu	14.8
38	Ziraki	15
39	Margobi	17.4
40	Chashma-Dushon	18
41	Yakkachinar	18
42	Sangdara	18
43	Dzhilga	20.8
44	Kaduchi	21
45	Kayragach severnyy	22
46	Kayragach yuzhnyy	22.8
	4-5 points	
47	Kaftarkhana	14.8
48	Shar-shar	15.5
49	Sadvinsovkhoz	15.6
50	Gilot	16.8
51	Kaynar	17.8
52	Langar-Kalon	18.5
53	Osmanbegi	19
54	Kipchak	20
55	Kiyen-Chashma	21
56	Imon-Ali	21.2
57	Kutal'	21.5
58	Chukurak	22
59	Dagana	22.3
60	Pushtion-bolo	23
61	Aral	25
62	Boggai	25.6
63	Chukurak	26
64	Uch-Kala	26.5
65	Kurban-Sheit	29
	4 points	
66	Komsomolabad	11
67	Devdor	12
68	Murgak	12.8
69	Novobad	13.8
70	Kaftar	13.8
71	Kashar (Gulabad)	15
72	Shuroabad	15.6
73	Kaduchi (3 km east)	18.7
74	Tutbulak	24

Table 2 (cont'd)

No. in order	Location	Δ, km	No. in order	Location	Δ, km
75	Bacha-Mazar	25	105	Olimtay	43
76	Bagarak	25.5	106	Chil'cha	47.4
77	Khul'bek	26	107	Kangurt	55
78	Sary-Maydon	26	108	Khovalinig	56
79	Garab	26.7		3 points	
80	Taskala	27.2	109	Chol-Sartis	21.5
81	Kolkhoz imeni Lenin	27.5	110	Dangara	53
82	Ak-Mazar	27.7	111	Pervomaysk	68
83	Tudaboyen	28	112	Obi-Garm	101
84	Tugul	29	113	Komsomolabad	111
85	Tanapchi	29.8	114	Garm	140
86	Chubek I	30.4	115	Chusal	155
87	Chubek II	30.8		Felt	
88	Muminabad	30.8	116	Khirmandzhou	26
89	Kuduk	30.8	117	Iol	30
90	Sovetskiy	32.5	118	Shagon	31
91	Guliston	33	119	Gidroizmeritel'nyy Center	
92	Shagmon	44	119a	Dushanbe	120
93	Kuybul'yen	45.5		Not noted	
94	Sharak	46	120	Parkhar	59
95	Chor-Chashma	47	121	Kyaylsu	72
96	Sovkhoz imeni Lakhuti	48.5	122	Kurgan-Tyube	95
	3-4 points		123	Pyandzh	98
97	Novyy bagarak	23.3	124	Nurek	79
98	Karim-Berdy	24.8	125	Seismicheskiy Settlement	133
99	Dagana	29	126	Khorog	150
100	Moskovskiy	30	127	Ishtion	155
101	Guliston	31.2	128	Dzhirgatal'	186
102	Bakh	32.8	129	Isfara	260
103	Dastidzhum	35.5			
104	Razvilka Olimtay	38.8			

The Muminabadsko-Shuroabadskiy syncline is sharply asymmetric. Its western limb is gently sloping and the eastern--steeply dipping.

In the region under discussion, geological-geophysical methods [2] were used to single out the buried local plicated and disjunctive structures.

For example, on the eastern limb of the Kulyabskiy anticline are located the buried Sary-Chashminskiy and Lilikutalskiy diapirs.

East of Kulyab, throughout the entire region from south to north, extends the buried Garabskiy anticline. Its southern part is formed by the Sary-Chashminskiy diapir, which with its long axis is extended in a northwest direction and is placed at an angle of 45° to the strike of the basic structures.

The Garabskiy anticline and the Sary-Chashminskiy diapir from the south and the southwest are rounded by the hidden Yuzhno-Khodzhamuminskiy fault. The northern limb of this fault is lower than the southern.

North and south of Kulyab pass two sublatitudinal hidden faults: the northern--the Gilotskiy, and the southern--the Kuliakhmoskiy. These disjunctives of the Hercynian deposit were activated by Alpine movements. On the territory under discussion three transverse uplifts were revealed [3]: the Shuroabadskoye, Ust'-Yakhsuyskoye and Akdzharskoye.

The deformations of the tidal terrace attest to the modern movements related to the transverse uplifts.

Researchers of the transverse uplifts [4] are coming to the conclusion that the transverse uplifts are formed during the entire newest stage, the faults are often confined to their limbs and, finally, these structures in a number of cases have visible seismogenicity. In addition, the abundance of earthquakes with varying depth of focus indicates the existence of unceasing present-day movements in the area being discussed. This indicates that the present movements take place both in the base and in the upper structural levels.

Taking part in the investigation of the results of the earthquake were associates of the Institute of Earthquakeproof Construction and Seismology of the Tadzhik SSR Academy of Sciences, Kh. M. Mirzobayev, T. N. Nizamov and A. A. Kon'kov--head of the seismological station at Kulyab.

As the result of the macroseismic investigation, information was obtained on the perceptibility from 130 population centers (Table 2). This earthquake was manifested most strongly at the population centers of Kulyab, Sary-Chashma and Balkhovi. Many buildings and structures were damaged here.

The city of Kulyab (6-7 points, 10 km) is located on the ancient alluvial fan of the Tebolyay River. From the surface the alluvial fan is covered by loesslike deposits up to 10 meters thick. Sometimes its deposits (dense coarse gravel) emerge on the surface, with a thickness reaching 100 meters and more.

The earthquake began with moderate vibrations, gradually turning into very strong ones. For example, the panelboard building of the seismological station, during the maximal vibrations seemed to be lifted from the foundation and rocked, like a cradle, at right angles to the long axis on the plane from north to south; the tops of trees were deflected 1-1.5 meters from their usual position; in the houses, on all the stories, household objects fell (clocks, books, vases, etc.). The azimuth of the fall of the objects and arrival of the vibrations was 130-150°.

As a result of a study of the buildings in the city it was ascertained that most of the type "A" structures sustained second degree damage, and the rest --third degree. Among the latter were the pedagogical school, the civil registry office, schools Nos 2 and 3, etc.

In many type "B" structures first degree damage was observed, and in some houses--second degree. In buildings that sustained the shock there were third-degree damages. For example, in the classroom wing of the pedagogical institute, both end walls on the second floor level broke away from the interior walls and were broken by cracks into blocks.

Kishlak Sary-Chashma (6-7 points, 11 km) is located on the terraces of the Dzhilga say. The terraces are formed by loesslike loams up to 4 meters thick, under which lie the alluvial gravel deposits of the Dzhilga say. At the edges of the say are encountered outcrops of bedrock--dense red sandstones.

At Sary-Chashma there are type "A" structures in which second-degree damage was formed, and in many buildings third-degree damage was observed. For example, the hospital, kindergartens and some apartment houses were considered to be wrecked. In type "B" structures second-degree damage was also observed, and in some--third-degree.

Of the five buildings (type "B") of the boarding school, two sustained third-degree damage: the northern outer walls broke away along the masonry from all the inner and outer walls (in the first building--the longitudinal wall, and in the second--the end). The width of the cracks along the fracture was at least 5 cm. In some rooms the inner walls were broken into blocks. In many chimneys the upper parts collapsed in a direction of 330-340° (Fig. 1). Crumbling and negligible rock slides were noted everywhere on the cliffs of the Dzhilga say.

Kishlak Balkhovi (6-7 points, 3.5 km) is located on both banks [word illegible] of the tributary of the Tebolyay River. The houses of a kishlak [mountain village], located on the right bank of the river, directly on the river gravel deposits, suffered less than those on the left bank.

The leftbank part of the kishlak is located on a terrace above the floodplain, adjacent to the slope. The terrace is formed by loesslike loams up to 4 meters thick, which lie on the river gravel deposits. In this part of the kishlak, in many type "A" structures second-degree damage was observed, and in some buildings--third degree. For example, a new house ("pokhsa") was entirely broken up by through vertical cracks into blocks.

In addition, two horizontal cracks were clearly singled out (a sign of the presence of a vertical component). The intensity of the shock here can also be judged by the fact that the jolt threw a woman who was seated to the ground along an azimuth of 210°.

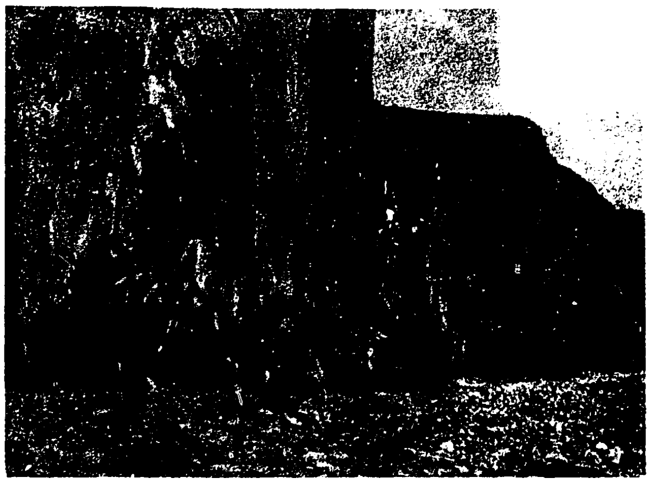

Figure 2. Fall of Bedrock in the Region of Balkhovi

Large slides, from which the dust remained in the air for a long time, occurred on the slopes of the surrounding mountains and cliffs of the says as a result of the earthquake. One kilometer below the kishlak, on the right side of the say, bedrock fell (Fig. 2).

The coordinates of the main jolt and 11 strong repeated jolts, determined by means of the azimuths of the seismological station at Kulyab, coincide with the central part of the zone of maximal temblors. The instrument epicenters, determined by the Institute of Earthquakeproof Construction and Seismology of the Tadzhik SSR Academy of Sciences and the Institute of Physics of the Earth, are located 6 and 30 kilometers south respectively of the zone of maximum vibrations. This discrepancy between the instrument and macroseismic epicenters is characteristic of the region under discussion. The possibility is not ruled out that this depends on the unfavorable location of the seismological stations for the given area.

The depth of the focus was determined according to the intensity and magnitude, according to the equation of the macroseismic field in the form $I_0=bM-\nu\lg h+c$ [5]. Used in this formula were regional coefficients, the numerical values of which we obtained for the Tadzhik depression ($b=1.44$, $\nu=3.9$, $c=3.4$) [6]. The depth of the focus, determined in this way, was 11-12 km.

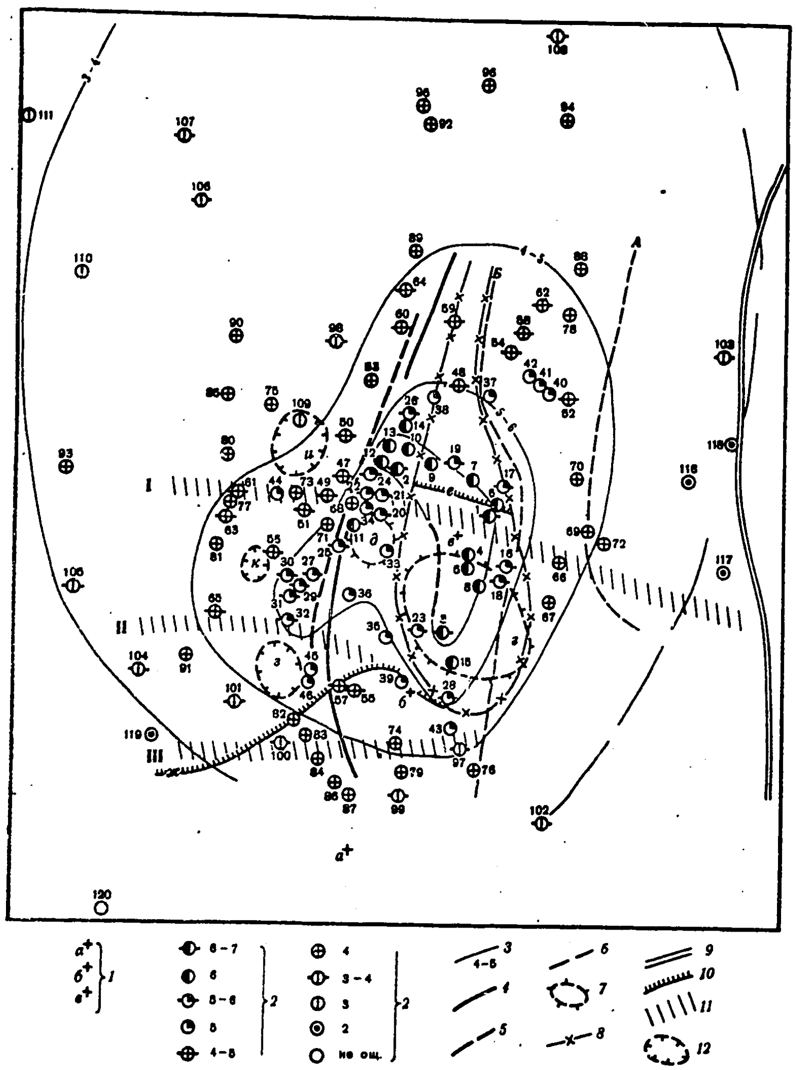

Figure 3. Map of Isoseismal Lines of Kulyab Earthquake on 2 April

1--epicenter according to instrument data: a--IZF; b--TISS; c--seismological station at Kulyab; 2--intensity; 3--isoseismal lines, points; 4--Kulyabskiy anticline; 5--assumed fault; 6--synclines; A--Muminabadsko-Shuroabadskaya; B--Turkaninsko-Dzhilginskaya; 7--buried diapirs; d--Sary-Chashminskiy; e--Lilikutalskiy; 8--buried Garabskiy anticline; 9--deep Karakul fault; 10--hidden fractures; f--Kuliakhmoskiy;
[Key continued on following page]

Key-cont'd: g--Yuzhno-Khodzhamuminskiy; 11--transverse uplifts: I--Shuroabadskoye; II--Ust'-Yakhsuyskoye; III--Akdzharskoye; 12--salt domes; h--Khodzhamumin; i--Khodzhasartis; j--Ortaboz

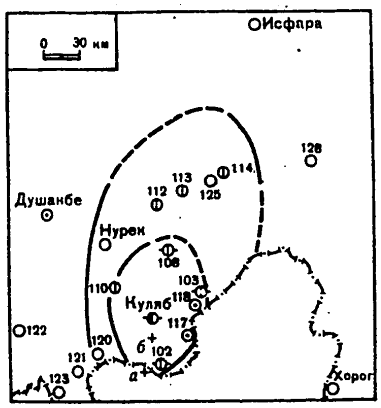

Figure 4. Isoseismal Lines of Kulyab Earthquake on 2 April (Distant Zone)

For Conventional Designations See Fig. 3

Table 3. Parameters of Isoseismal Lines of Kulyab Earthquake on 2 April

(1) I, балл	(2) Расстояние по азимуту, км				(3) Диаметр		$\bar{r}$ (Δ эп.)	$\bar{D}$ (Δ гип.)	S, тыс. км²
	S–W	S–E	N–W	N–E	d_{max}	d_{min}			
6–7	3	3	3	3	15	5	4	13	0,06
5–6	7	7	4	10	28	21	12	17	0,46
4–5	17	13	10	26	56	35	22	25	1,5
3–4	28	24	46	70	108	75	45	46	6,2
2–3	50	45 (?)	75	175	225	126	84	85	22

Key:

1. I, points
2. Distance according to azimuth, in km
3. Diameter

On the basis of the data from Table 2 a map of the isoseismal lines was drawn up (Fig. 3). In general outline, the isoseismal lines have an irregular oval shape, extended in a southwest-northeast direction, along the strike of the main geological structures. The Pleistocene seismic zone, however, has an "unusual" gamma-shaped form: it stretches from the Sary-Chashma Kolkhoz in the south to the kishlak of Balkhovi in the north, and then changes its strike at an obtuse angle ($110 \pm 5°$) toward the northwest and, including the city of Kulyab, closes up along the floodplain of the Yakhsu River. As can be seen, the Pleistocene seismic area is seemingly composed of two identical sections--the south and the northwest.

The next, 5-6 point isoseismal line generally repeats the outlines of the Pleistocene seismic area, but to the northwest approaches right up to (up to 1 km) the 6-7 point isoseismal line. To the southwest the 5-6-point isoseismal line, on the contrary, is 18 kilometers away from the 6-7-point one in the form of a protuberance in the direction of the salt diapir of Khodzhamumin.

The 4-5-point isoseismal line is an oval, narrowed from the south, but on the whole duplicating the contours of the preceding isoseismal line.

The 3-4-point isoseismal line is also constricted from the south (along the Pyandzh River), while in the western and, particularly, in the northern directions, departs from the 4-5-point isoseismal line for considerable distances (see Fig. 4 and tables 2 and 3).

The 2-3-point zone is ellipsoid in shape, and its long axis is extended along the strike of the principal geological structures. Data on the intensity from Tashkent and Samarkand were not included in the lists, since there the earthquake was felt only on the 4th-8th floors with an intensity of 2 points.

Estimates of the damping coefficient of the intensity were made according to the methodology of work [7]. The values of the damping coefficients of the intensity (ν) for the earthquake on 2 April were obtained at different azimuths. In the southwestern direction, ν = 3.8-4.4, in the southeastern --3.7-3.8, in the northwestern--3-3.2 and in the northeastern--2.4, over an area S--3.6. The greatest decay occurred in the southwest direction. This was apparently related to the absorption of seismic energy by the Yuzhno-Khodzhamuminskiy fault (flexure-fault zone) and the salt diapirs. In the southeast sector the increased decay was more probably caused by the abrupt sinking in the western direction of the focus, which is attested to by the almost identical distances between the isoseismal lines of the highest points. It is possible that the closely located deep Kara-Kul fault in this sector played a certain role in increasing the decay.

In the northeastern direction (see Fig. 4), the seismic energy released during the earthquake was propagated with the least decay.

In the northwestern sector the isoseismal lines of the highest points (6-7 and 5-6) approach each other almost to the meeting point. This indicates that a sharp damping of seismic energy is observed here (at 1 km--1.5 points) that may create only a powerful shield in the form of a renewed fault zone [8]. We proposed the existence of such a fault only when studying the Kulyab earthquake on 21 May 1969 [9], the focus of which was genetically connected with the fault mentioned, and was located 10 km north of Kulyab. Guided by the data obtained as the result of analyzing the damping of the seismic energy of the earthquake on 2 April 1973, we can indicate with greater certainty the existence of a concealed fault along the western limb of the Kulyab anticline. The formation of a flow near the 5-6-point isoseismal line in a southern direction is apparently also connected with the existence of the fault mentioned, along which an increase in the intensity occurred.

The possibility of the existence of a fault is confirmed by the Upper Jurassic salt diapirs emerging at the surface.

The location of the isoseismal lines and Pleistocene seismic area discussed above makes it possible to draw certain conclusions as to the origin of the earthquake. The unusual, gamma-shaped form of the Pleistocene seismic area suggests the idea that the shove in the focus occurred not in one, but in two possible directions at the same time, which should be perpendicular to each other; we observe, however, an obtuse angle between them ($110 \pm 5°$).

Such cases also occurred earlier--in the Carpathian (1907) and Chatkal' (1946) earthquakes. The predominant mechanism of the focus in this type of earthquake, as N. V. Shebalin considers, is the "puncturing of the angle" [10].

The conformance to principle revealed concerning the succession by way of the long axis of the first isoseismal line of the form of the focus [6, 11] makes it possible for us to draw certain conclusions for the earthquake on 2 April, in which there were two possible faults: a fault in the meridional direction, which was unknown before the earthquake, and the concealed, Kuliakhmoskiy, sublatitudinal strike. The latter was revealed only within the limits of the buried Garabskiy anticline and was located at an angle of 90° to it. The possibility is not excluded that the Shuroabadskoye transverse uplift played a certain role in the preparation of this earthquake.

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EARTHQUAKES IN NORTHERN TIAN SHAN

B. M. Urazayev, Zh. A. Latypov, A. B. Ospanov, G. P. Vyrupayeva, L. A. Degtyareva

In 1973 observations were made in the Northern Tian Shan seismic zone at seismological stations at Alma-Ata, Kurmenty, Chilik, Kzyl-Agach, Fabrichnaya, Ili, Chimkent, Kurty, Dzhambul and the Central Seismological Station. In addition, data from stations at Talgar, Naryn, Przheval'sk and Kadzhi-Say were drawn into the processing regularly. This network of seismological stations makes it possible, as is seen from the map of the repesentativeness of the earthquakes, to study earthquakes with K=8 on essentially the entire territory of Northern Tian Shan and only within the limits of individual small zones, with K=7.

Temporary stations at Ili, Kurty, Dzhambul and the Central Station were opened in 1971-1973, and the data on them was not included in work [1]. Considerable changes in the parameters of the equipment were made at other stations in the zone during this time (Table 1).

A study of the seismicity, just as in the preceding years, was made in the area bounded by the coordinates 41°40'-44°30' N lat and 75°00'-80°00' E lon. A total of 108 earthquakes was recorded on this territory in 1973, and they were distributed with respect to energy classes as follows:

K	7	8	9	10	11	12
Number of earthquakes	17	56	24	8	-	3

The coordinates of the epicenters were found by the isochrone method. The energy class of the earthquakes was determined according to Rautian's nomogram [2].

In 1973 mainly weak earthquakes with $K \leq 12$ occurred on the territory under discussion. There were only three earthquakes recorded with K=12, and there were none with K=11. The shift of the epicenters of the earthquakes is shown in Figure 1. The earthquakes with K=12 occurred on the northern slope of the Kirgiz Range, in the central part of the Terskey-Alatau Range, and in the northern part of Kokshaal-Tau. The Kurmentinskaya and Przheval'skaya zones and the Iliyskaya basin are singled out by increased seismic activity manifested by weak earthquakes.

Table 1. Basic Paramaters of the Recording Equipment at Seismological Stations in Northern Tian Shan

(1) Станция	(2) Тип аппаратуры	Z		E–W		N–S		Дата определения постоянных (1973 г.) (3)
		V_m	T_m	V_m	T_m	V_m	T_m	
ЦСС (4)	СКД+ГК-VII (17)	1000	0,2–20,0	1000	0,16–20,0	1000	0,23–18,5	1.III
(5) Алма-Ата*	СК-3М+ГБ-IV (18)	5600	0,14–1,9	5500	0,15–1,9	5400	0,18–1,85	
(6) Алма-Ата	СК+ГК-VII (19)	1350	3,0–11,0	1100	0,2–9,0	1100	0,2–9,0	5.VII
(7) Курменты	СК-3М+ГБ-IV	30700	0,1–1,8	30000	0,1–1,7	33000	0,1–1,75	15.V
(8) Чилик	То же (15)	20200	0,1–1,55	20100	0,1–1,5	20300	0,1–1,3	3.XI
(9) Кзыл-Агач	"	40000	0,1–1,4	40000	0,1–1,6	40000	0,1–1,65	9.IX
(10) Или*	"	15300	0,1–1,7	15200	0,1–1,55	15200	0,1–1,6	17.IX
(11) Фабричная	"	20300	0,1–1,30	20000	0,1–0,9	20000	0,1–1,2	25.XII
(12) Курты*	СК-3М+ГК-VII	23250	1,0–1,9	20150	0,75–2,0	20500	0,9–1,95	10.XII
(13) Чимкент	СК+ГК-VII	1000	0,25–11,0	1000	0,25–11,0	1000	0,25–10,0	7.VI
(14) Джамбул*	СКД+ГК-VII	1300	1,2–10,0	1200	1,2–10,1	1250	1,2–10,0	8.X
	СК-3М+ГБ-IV	5000	0,1–1,75	5000	0,1–1,7	5000	0,1–1,7	

(16) * Временные сейсмические станции.

Key:
1. Station
2. Type of Equipment
3. Date of determining constants (1973)
4. Central Seismological Station
5. Alma-Ata*
6. Alma-Ata
7. Kurmenty
8. Chilik
9. Kzyl-Agach
10. Ili*
11. Fabrichnaya
12. Kurty*
13. Chimkent
14. Dzhambul*
15. Same
16. *--temporary seismological stations
17. SKD+GK-VII
18. SK-3M+GB-IV
19. SKD+GK-VII

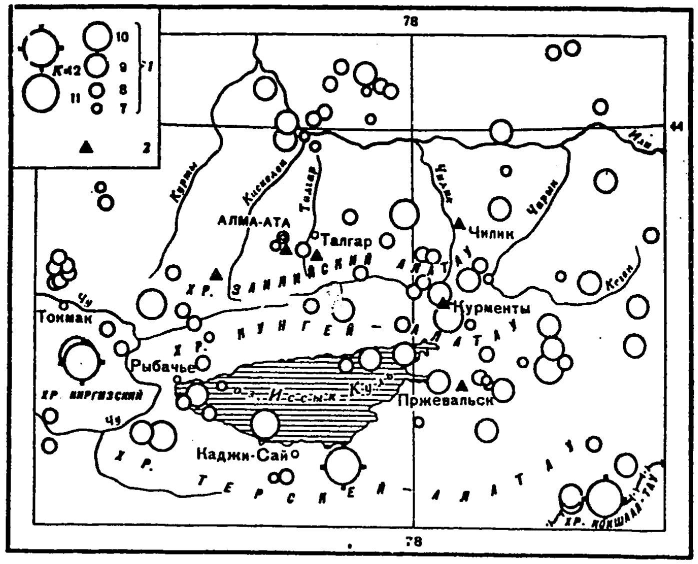

Figure 1. Map of Epicenters of Earthquakes in Northern Tian Shan

1--energy of earthquakes;--seismological stations

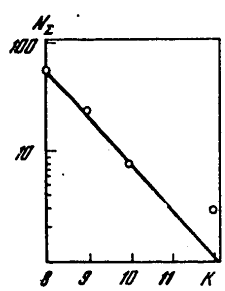

Figure 2. Graph of Frequency

As compared with the preceding years, in 1973 the number of earthquakes was noticeably reduced. The magnitude of the angle of incline of the frequency graph (Fig. 2) of the territory under discussion is 0.43.

Figure 3 shows a map of the seismic activity in the region, drawn up on the basis of a map of the epicenters with $K \geqslant 8$ by means of a circular surveyor's plane with the number $N_\Sigma = 5$. The averaged radii were determined from the formula

$$R = \sqrt{\frac{1000 N_\Sigma (1 - 10^{-\gamma})}{AT\, 10^{\gamma}\, (K - K_0)}}.$$

In this case the values of 1.0; 0.7; 0.5; 0.2; 0.1; 0.05; 0.02 and 0.01 were assigned to the isolines of activity, A.

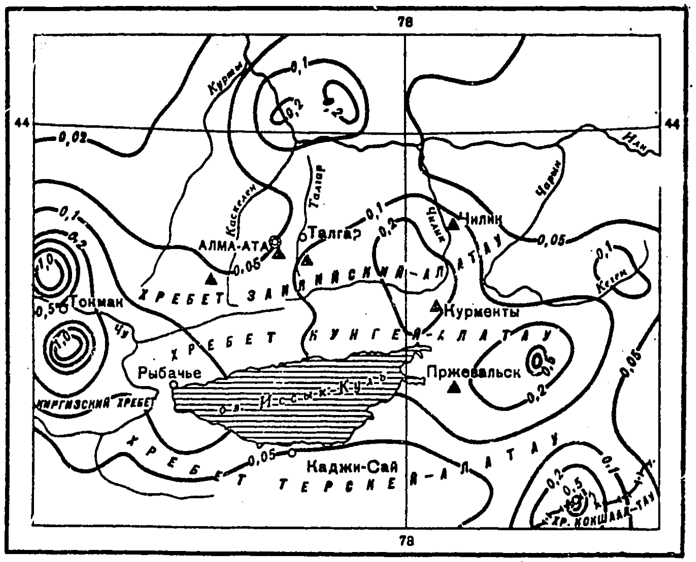

Figure 3. Map of Seismic Activity

As compared with 1972 the level of activity with the limits of the territory under discussion on the whole was reduced. The area encompassed by the isolines with the activity value of 0.2 was sharply reduced and outlines the Kurmenty, Przheval' zones, the spurs of the Kirgiz Range and the lower reaches of the Chu River. The sections on the northeastern slopes of the Terskey-Alatau and Kokshaal-Tau ranges are singled out by increased activity.

Outside the limits of the area being described, on the northern slopes of the Boro=Khoro Range, on 2 June 1973, at 23:57 (Greenwich time), 550 km to the southeast of Alma-Ata in the strip near the boundary, there was an earthquake (M=5.7). It was felt on USSR territory with the greatest intensity of 5 points in the settlement of Druzhba (Fig. 4, No 1, Table 2), 140 km from the epicenter. The coordinates of the epicenter are: $\varphi = 44.2°$ N, $\lambda = 83.5°$ E, M=5.7. In the settlement strong vibrations were felt by the inhabitants who were outdoors and indoors. The swaying of hanging objects and rattling of glasses and dishes were noted; people who were sleeping woke up and ran out their houses. Wooden and frame houses were not damaged.

At points where the intensity of the tremor was estimated at 4-5 points, the earthquake caused alarm; people who were asleep woke up and people fled their homes. Cupboard doors opened and glass in windows and dishes clinked. A tractor vibrated from the tremors. There was a landslide in areas of steep, bare slopes.

Table 2. Macroseismic Data on the Earthquake on 2 June

No, in order	Location	Δ, km	No, in order	Location	Δ, km
	5 points			3-4 points	
1	Druzhba	140	18	Kolzhat	246
	4-5 points		19	Urdzhar	360
2	Dzhalanshkol'	190		3 points	
3	Koktuma	240	20	Dubinskiy	286
4	Dzerzhinskoye	264	21	Dardamty	294
5	Konstantinovka	266	22	Makanchi	304
6	Bakhty	282	23	Tashkarasu	333
			24	Chundzha	336
	4 points		25	Podgornoye	343
7	Zharbulak	240	26	Aksu	360
8	Khorgos	255	27	Tastesken	406
9	Lepsinsk	276			
10	Panfilov	284		2-3 points	
11	Andreyevka	294	28	Kapal	374
12	Rybach'ye	298			
13	Koktal	300		Not felt	
14	Uch-Aral	301	29	Narynkol	323
15	Pokatilovka	301	30	Kolkhoz imeni Abzhanov	381
16	Antonovka	307			
17	Podgornoye	391	31	Kzyl-Agash	405
			32	Taldy-Kurgan	424
			33	Lepsy	429
			34	Chilik	435
			35	Sary-Ozek	445

At centers with a 4-point tremor, all the inhabitants that were not moving around felt the earthquake. Dishes and window panes rattled and hanging objects swayed. The inhabitants who were moving around did not notice the earthquake. The focus of the earthquake was located in the earth's crust. The map of the isoseismal lines is given in Figure 4.

As can be seen, the 3-4-point isoseismal lines have a more or less circular shape, with the average radii 300 and 405 km respectively. If one considers the fact that the 5-point isoseismal line passes near the settlement of Druzhba, then the damping of the intensity between the 5-4-point isoseismal lines occurrs "normally," with a damping coefficient value of 3.2, and an anomalous high damping is observed between the 4-3-point isoseismal lines, which obviously stems for the insufficiently accurate determination of the position of the 3-point isoseismal line.

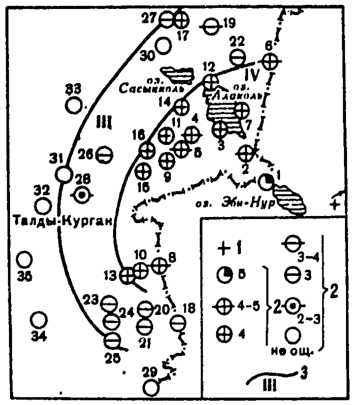

Figure 4. Diagram of the Isoseismal lines of the Earthquake on 2 June Drawn Up by A. Dosymov, A. Nurmagambetov and A. Sadykov

1--macroseismic epicenter; 2--intensity; 3--isoseismal lines

Table 2 shows the consolidated data on the magnitude of the earthquake at the population centers studied.

Catalog of Earthquakes in Northern Tian Shan in 1973

Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Класс точности	K	№ района
		φN	λE			
1	2	3	4	5	6	7

Key:

1. Date
2. Moment of origin, hrs, mins, secs
3. Coordinates of epicenter: φ °N
4. Coordinates of epicenter: λ °E
5. Accuracy class
6. K
7. Number of region

January

4	00 23 04,0	43°20′	77°47′	A	8	4
5	15 18 36,0	44 17	77 18	A	8	1
6	09 54 54,2	42 05	79 28	A	8	11
7	09 28 04,0	42 39	75 17	A	8	10
9	18 00 45,3	43 14	78 05	A	8	5
12	19 48 53,3	43 58	75 45	A	9	14
16	11 44 21,8	42 48	76 10	A	8	3
19	10 45 06,4	42 52	78 20	A	8	5
22	07 59 09,0	42 05	75 49	A	9	10

1	2	3	4	5	6	7
24	07 37 11,8	43 29	77 56	A	10	2
27	14 23 36,0	44 08	79 38	A	8	1
28	10 07 38,0	42 43	75 27	A	8	
29	03 17 59,0	42 55	77 09	A	8	
31	09 45 26,0	41 46	79 16	A	9	
			February			
3	06 12 07,8	44 14	77 48	A	8	1
4	11 09 49,0	42 27	78 36	A	8	8
8	06 46 20,0	41 57	79 43	A	9	11
	11 19 43,0	43 05	75 04	A	8	3
9	21 20 30,0	42 40	79 50	A	9	7
10	11 44 37,8	43 04	75 59	A	8	3
11	10 57 52,0	44 14	76 42	A	9	1
12	19 18 50,5	42 10	76 46	A	10	7
16	07 14 15,6	42 48	79 10	A	8	8
	16 37 04,0	43 06	78 28	A	9	5
24	16 50 02,0	42 13	78 01	A	7	6
27	00 45 54,0	42 10	75 00	A	8	10
	09 56 02,4	43 08	75 00	A	8	3
			March			
2	06 33 25,6	44 05	77 13	A	8	2
5	10 49 37,6	42 35	77 39	A	9	6
	14 36 30,6	43 06	78 38	A	7	5
6	02 29 54,0	44 22	77 21	A	7	1
	10 40 04,0	43 00	75 00	A	8	3
8	21 29 21,0	42 27	78 37	A	8	8
13	17 11 23,3	42 49	79 07	A	9	8
18	05 44 08,0	42 33	79 07	A	8	8
19	22 04 23,3	42 10	78 35	A	9	7
	22 32 43,1	43 17	76 50	б	8	4
	23 48 46,2	42 53	77 23	б	9	4
23	09 44 42,0	43 35	75 19	A	7	13
27	08 53 22,0	42 04	75 53	A	10	7
30	10 49 43,0	44 03	77 09	A	8	2
			April			
14	19 49 44,0	41 58	77 24		12	7
24	12 40 51,0	43 04	79 12		7	9
			May			
1	16 38 12,4	43 01	78 01		8	5
	17 03 06,2	44 30	79 23		8	1
2	15 46 46,5	42 28	78 33		8	8
5	17 08 06,3	42 49	77 55		8	5
8	23 05 17,2	41 44	79 18		9	11
20	06 55 19,5	43°20′	80°00′		8	9
21	14 30 51,6	43 36	78 32	б	8	2
22	13 08 09,3	43 44	78 47		7	2
23	06 03 05,0	44 16	77 42		8	1
	20 31 56,3	42 56	77 19		8	4

1	2	3	4	5	6	7
24	22 13 54,2	42 56	79 51		9	9
	22 33 09,5	42 00	79 38		9	9
27	01 34 08,4	42 37	77 54		9	6
30	02 11 53,6	43 26	77 52		7	5
31	11 49 04,5	42 08	76 50		8	7
	20 55 19,0	43 57	76 52		9	2
			June			
5	18 02 59,0	42 24	78 11		9	6
23	07 35 28,0	44 29	79 13		8	1
26	16 28 28,7	43 13	78 10	6	8	5
			July			
2	01 43 37,6	42 53	75 48		10	3
3	11 19 20,1	43 00	75 01		8	3
5	06 35 27,6	42 50	78 18		10	5
19	00 13 42,0	43 25	77 28	6	8	4
25	09 34 31,0	42 32	77 27		8	6
29	16 24 08,3	42 14	76 20		8	7
			August			
2	23 54 43,0	42 34	79 13		8	8
6	04 09 39,0	42 24	78 42		9	8
8	06 29 04,0	42 51	76 04		8	3
10	10 36 46,0	43 53	77 08		7	2
17	13 06 46,0	41 45	79 23		8	11
20	12 58 36,0	42 39	79 09		9	8
	22 06 50,8	42 49	78 28		7	8
22	20 28 43,5	42 34	76 08		8	3
23	20 00 30,0	42 35	75 10		10	10
25	17 51 09,5	43 00	78 12	a	9	5
27	10 55 51,0	43 01	77 20	6	8	4
	11 25 56,0	43 30	75 21		8	13
29	09 51 36,0	42 38	78 37		8	8
	18 19 10,0	42 35	75 10		10	10
			September			
1	12 32 32,0	42 32	75 13		12	10
	21 35 17,0	42 35	75 10		8	10
15	10 08 53,2	44 13	77 36		7	1
	16 54 09,5	42 25	76 27		7	6
			October			
1	11 46 15,0	43 30	78 42		9	2
	12 23 32,5	43 03	75 05		8	3
3	15 31 23,5	42 41	76 19		7	3
4	22 14 57,0	42 21	76 11		9	7
24	04 51 32,0	41 44	79 30		12	11
25	17 01 00,3	42 31	79 05		10	8
29	22 23 53,6	43 32	77 57	a	8	2

1	2	3	4	5	6	7
			November			
12	22 13 39,5	44°03'	77°38'		7	2
13	13 42 48,0	41 52	76 58		8	12
	23 10 23,7	41 52	76 58		7	12
23	11 06 27,0	43 56	77 01	6	7	2
27	15 14 47,3	42 19	76 08		8	7
			December			
4	10 09 26,0	43 14	77 02	A	7	4
8	20 32 38,3	43 03	79 28		8	9
9	17 41 05,3	43 02	78 05	a	8	5
	21 43 37,5	43 32	78 54		7	8
19	10 51 41,0	43 05	75 00		8	3
	18 56 46,0	44 01	76 54	A	9	2
21	19 07 33,2	42 36	75 08		8	10
24	16 22 42,0	43 09	77 34		8	4
26	10 07 53,6	44 20	77 36	A	9	1
	15 40 45,2	43 10	78 33		8	5

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EARTHQUAKES IN ALTAY AND SAYAN

I. D. Tsibul'chik, A. G. Filina

Seismic observations in the Altay-Sayn zone in 1973 were made by eight permanent seismological stations. The equipment and methodology for determining the epicenters of the earthquakes remained the same as in 1972. The energy class, just as before, was estimated according to Rautian's nomogram.

In characterizing the seismicity as a whole, it should be noted that the activity of Altay and Sayan in 1973 was considerably lower than the activity in the preceding three years [1-3]. This is indicated by the absence of strong earthquakes with $K > 13$ and the small number of earthquakes with K=12 and 13. A total of 102 earthquakes was recorded in 1973, and their distribution by energy classes is shown below:

K	9	10	11	12	13
Number of earthquakes	65	19	16	1	1

The number of earthquakes with K=11 in 1973 was considerably higher, while the number of earthquakes of the 9th-10th classes was almost the same as in preceding years. As the result of this, the frequency graph for 1973 has an atypically low value of angle of incline: $\gamma = 0.35$. After determining the value of γ by years for 11 years (beginning with 1962), we ascertained that this atypically low value for the angle of incline γ was only in 1964 and that in the other years it always remained within a range of 0.41-0.49, which, taking into account the errors in the observations, is in accordance with the average value, $\gamma = 0.45$, calculated during 11 years of observations.

Of the most active sections of the Altay-Sayn seismic zone in 1973, special not should be taken of the region of the northeastern part of the boundary of Tuva and Mongolia, where a great density of epicenters was observed, connected with the increase in the number of weak jolts with $K < 11$, as well as the region of the Ureg-Nur earthquake on 15 May 1970, where, just as before, a series of aftershocks continued, which followed this earthquake, the total number of which in 1973 was less than in 1972. The number of jolts with $K \geqslant 9$, however, rose, which can be seen from the table.

Table

K	1970 г.	1971 г.	1972 г.	1973 г.
5–7	2046	273	109	62
8	808	133	39	28
9	307	32	9	15
10	155	13	6	10
11	48	3	2	4
12	10	–	–	–
13	4	–	–	–
14	2	–	–	–

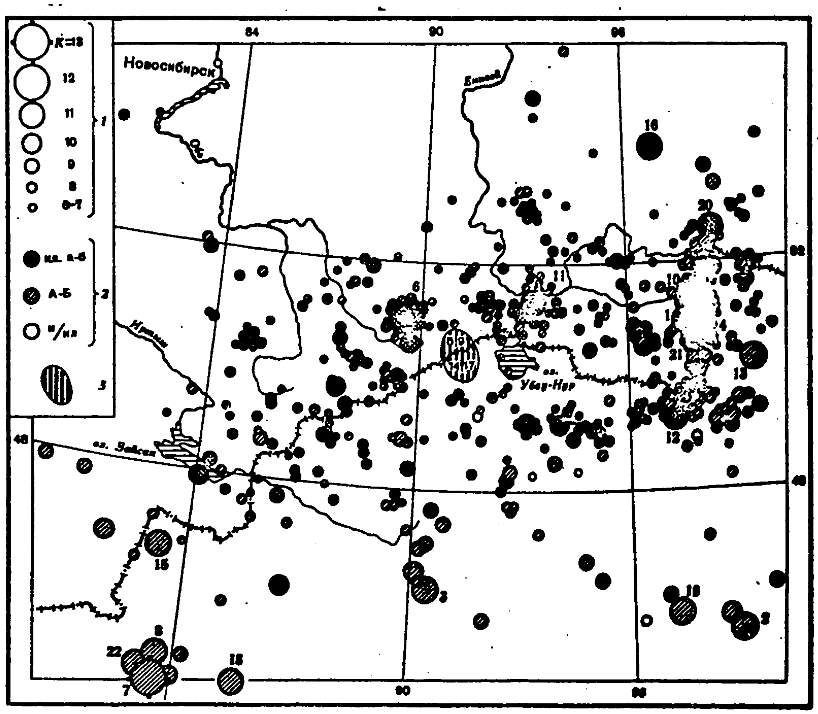

Figure 1. Map of Epicenters of Earthquakes in Altay and Sayan

1--energy of earthquakes; 2--accuracy of determining epicenters; 3--zone of aftershocks of earthquake on 15 May 1970

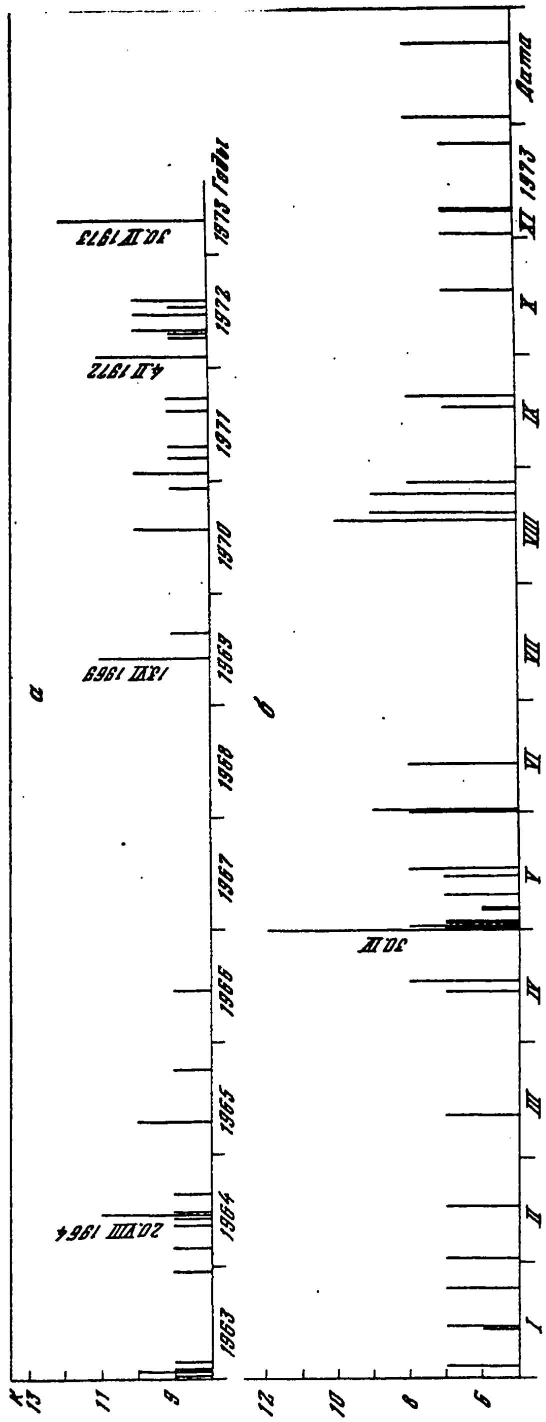

Figure 2. Graph of Time Dependence of Seismic Process for Region of Earthquake on 30 April

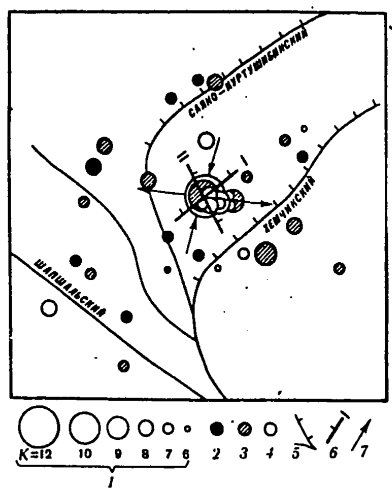

Figure 3. Map of Epicenters of Earthquake on 30 April and Subsequent Jolts

1--energy of earthquakes; 2--epicenters of earthquakes during the period from January-April 1973; 3--epicenters of aftershocks of earthquake on 30 April; 4--epicenters of earthquakes during the period of August-December 1973; 5--deep tectonic faults and direction of dip; 6--possible faults in the focus and direction of the dip; 7--stress at focus of earthquake

The frequency graphs plotted for the aftershocks gave an atypically low value of the angle of incline, $\gamma = 0.24$, analogous to the result obtained for the zone as a whole. Figure 1 shows the zone of the aftershocks according to the data from 1973. Its linear dimensions are comparable with the dimensions of this zone in 1970, but increased as compared with 1971 and 1972, and the entire section seemingly shifted to the northwest.

A weakening of the seismic activity was noted in the epicentral zones of the earthquakes on 31 August with M=5.5 and on 26 February with M=5.7, in 1973. In the region of the first of them, in general no jolts with $K \geqslant 9$ were observed, which corresponds to the very low seismic activity of this region up until 1972. In the region of the Sangilenskiy earthquake (26 February 1972), up to 20 jolts with $K \leqslant 10$ were recorded. Here too, then, the seismic activity did not exceed the average level of activity before 1972.

On 30 April, at the juncture of Western Sayan and the Shapshal'skiy Range the only earthquake in 1973 occurred, with K=12. It is interesting that the region of the earthquake was relatively quiescent in the seismic respect for a number of years. In 1967-1968 there was not a single earthquake there with $K \geqslant 9$ (Fig. 2, a). Beginning with 1969, through 1972, the region was noticeably activated, and during this period there were up to 16 jolts with $K \geqslant 9$ and two of them with K=11. Then, after over six months of a lull, on 30 April 1973 an earthquake was registered with K=12, which was accompanied by a small series (May-June) of weak aftershocks (Fig. 2, b) after which the seismicity of this region again achieved the 1971-1972 level.

The epicenters of the earthquakes that preceded the earthquake on 30 April (from January to April), are located between the Shapshal'skiy, Sayano-Kurtushibinskiy and Khemchikskiy deep faults and clearly outline the region where the aftershocks of this earthquake are subsequently localized, and the weak jolts that followed from August to December (Fig. 3). The aftershocks, relatively uniformly distributed throughout the activated area, characterize the area of the focus, unusually large for earthquakes of the 12th energy class, extended in a northeast direction for up to 85 kilometers. Apparently this indicates that the energy accumulated in this amount was not fully released in the earthquake of 30 April and even stronger jolts were possible here.

The focal mechanism for this earthquake was determined from the method of A. V. Vvedenskaya. The shift components of plane I proved to be equal along a strike of 140°, and along the dip 36°, A_z = 50°, a = 54°; the shift components of plane II along the strike 240°, along the dip 13°, A_z =330°, a = 77°. For the compression stress A_z = 16°, a = 35°, the interstitial stress--A_z = 105°, a = 51°, and tensile--A_z =275°, a = 15°.

As can be seen, the area of the focus was in a state of nearly horizontal tension, running in a latitudinal direction. The axis of compression sloped toward the horizon at a steeper angle. According to the strike of the zone of the aftershocks, a single nodal plane moves after the fault in the focus and along the strike and along the dip it corresponds well to the strike and the dip of the Sayano-Kurtushibinskiy and Khemchikskiy deep faults. In this case the shift in the focus should be in the nature of a shift with a small fault component. In addition, it should be noted that the second nodal plane also has its own analog, and its strike corresponds well to the northwestern strike of the southern branch of the Sayan--Kurtushibinskiy fault.

The rest of the areas seismically active in the past years, such as the Mongolian Altay and the region of catastrophic Hangay earthquakes, were very little active in 1973.

Catalog of Earthquakes in Altay and Sayan in 1973

№ п/п	Дата	Момент возникновения, час, мин, сек	Координаты эпицентра		Класс точности	K	№ района
			φ°N	λ°E			
1	2	3	4	5	6	7	8

Key:

1. Number, in order
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ °N
5. Coordinates of epicenter: λ °E
6. Accuracy class
7. K
8. Number of region

January

	1	12 26 56	47,0	90,3	А	9	11
		21 31 56	52,3	98,6	А	9	3–4
1	5	16 14 11,0	50,85	97,70	б	11	3
	6	12 49 06,0	51,58	99,60	б	9	4
	10	16 59 38,5	50,57	89,75	б	10	1
	11	00 52 46	43,8	80,3		10	24
		04 24 33,0	50,40	91,20	б	9	1*
		07 44 21,5	51,00	97,80	б	9	3
	15	05 57 05	52,2	98,3	А	9	3
	19	15 05 42,5	51,95	83,60	а	9	1
	25	11 31 25,5	50,37	91,22	б	10	5*
		11 33 31,0	50,18	91,38	б	9	1–10*
	27	04 29 27,0	50,00	89,42	б	9	1
	29	02 03 10	50,8	98,0	А	9	3
		04 33 04	50,8	98,1	А	10	3
		17 36 13	51,0	98,0	А	10	3
	30	14 26 31	50,3	91,2	А	9	1*
	31	15 12 12	50,9	98,1	А	9	3

February

	1	10 36 00	51,0	97,8	А	9	7
	2	15 35 46	46,3	99,7	Б	9	25
	6	08 03 11,0	50,33	91,28	б	10	1*
	7	05 09 10	49,5	99,1	А	9	8
	12	18 02 14	50,3	91,3	А	9	1*
	13	16 37 24	50,3	98,2	А	9	7
2	15	11 20 58	45,5	98,7	Б	11	21
	19	18 44 04	46,5	95,1	А	9	11
	20	22 11 59	47,7	81,0	А	9	14
	21	04 45 15,5	50,28	91,10	б	10	1*
		06 40 50	47,4	90,9	А	9	11
3	22	01 44 48	46,2	90,5	А	11	11

1	2	3	4	5	6	7	8
				March			
	3	14 46 20	49,2	98,9	А	9	8
	6	15 58 01	51,9	98,0	А	9	3
	7	20 55 10,3	50,23	91,33	б	10	1*
	8	22 20 26	50,5	91,2	А	9	5*
	9	11 45 31,9	50,20	91,33	б	10	1*
	18	01 02 45	46,7	81,9	А	10	13
		12 55 07,5	50,40	91,17	б	9	5*
	20	18 10 59,0	49,13	94,00	б	10	10
4	21	12 55 31,8	50,82	98,00	б	11	3
	23	14 39 45,0	49,10	93,10	б	10	10
	26	03 25 16,0	52,03	95,83	б	9	3
5	29	18 07 43,2	50,63	91,02	а	11	5*
				April			
	1	12 55 35	49,1	98,4	А	9	8
	10	13 26 31	50,9	97,8	А	9	7
	15	08 19 47,5	48,88	94,37	б	9	10
	27	22 55 47,5	51,65	98,15	б	9	3
6	30	07 29 49,0	51,00	89,7	б	12	2
					(h=30 км, M=4,5)		
				May			
	11	06 58 31,6	50,33	91,14	б	10	1–5*
	14	03 29 35	49,6	97,4	А	9	7
	18	21 53 14,0	50,53	87,75	б	9	1
	26	11 16 36	48,3	92,6	А	9	10
	29	09 40 42,5	50,60	97,48	б	9	7
	31	00 38 21	51,0	89,7	А	9	2**
				June			
	1	14 39 28,0	53,63	98,70	б	9	4
7	2	23 57 06	44,2	83,5	А	13	24
	3	03 29 03	44,7	84,3	Б	9	12
8	5	05 30 34	44,7	83,5	А	11	24
	6	16 56 49	44,3	84,0	Б	10	12
	7	03 27 53	50,8	96,3	А	9	9
	9	13 20 10,2	51,47	98,03	б	10	3
	14	12 40 38,0	50,40	91,12	б	9	5*
		15 20 39	50,3	97,9	А	10	3
	19	07 45 20	53,3	98,9	А	9	4
	28	06 24 56,6	46,15	86,58	б	10	12
	29	23 16 24,5	50,17	91,33	б	10	10–1*
				July			
9	1	16 16 40,0	50,37	91,20	б	11	5*
	2	01 39 02	50,8	96,4	А	9	7
10	3	22 58 42,0	51,22	97,92	б	11	3
	5	04 17 32,0	50,22	91,40	б	9	1*
	10	03 55 24	45,8	98,5	А	10	2
	12	00 11 20	50,1	91,5	А	9	10*
	21	15 00 56,3	50,37	91,40	б	10	10*
11	25	19 32 57,0	51,27	93,25	б	11	6
	27	16 39 12	50,3	91,0	А	9	1*

1	2	3	4	5	6	7	8
				August			
12	2	13 11 31,8	49,25	97,20	б	11	8
	8	14 33 03	46,8	94,7	А	9	10
	10	05 03 04,4	54,90	93,30	б	9	4
13	13	15 48 25	50,2	99,5	А	11	23
	14	18 14 20,0	50,57	96,47	б	10	7
	17	16 12 03,2	51,07	89,65	б	10	2
14	18	10 18 42,0	50,2	91,0	б	11	5*
						(h=52 км, M=4,5)	
	19	00 24 48,8	50,92	89,90	б	9	2
	20	19 23 57,2	50,30	91,25	б	9	1*
15	23	17 23 27	46,6	83,3	А	11	14
	24	21 16 34,6	51,05	89,75	б	9	2
	29	18 30 30,0	50,80	96,38	б	9	7
				September			
	2	19 54 25	49,6	97,1	А	9	7–8
	3	17 59 43	50,7	91,0	А	9	5*
	7	00 12 53	50,6	96,3	А	9	7
16		12 21 23,0	54,00	96,9	б	11	4
	8	00 00 48,2	48,42	89,88	б	9	11
		01 45 05	47,0	90,3	А	9	11
	16	03 42 27,0	50,87	98,00	б	10	3
		19 23 33,0	51,25	97,88	б	9	3
	17	06 04 47,5	51,32	97,85	б	9	3
17	21	00 56 08,8	50,30	91,13	а	11	1*
	22	06 06 30,3	50,43	91,15	б	10	5*
18	26	12 42 54	44,3	85,5	А	11	12
19	29	21 14 53	45,8	97,2	А	11	11
	30	03 45 27,0	50,45	94,93	б	9	6–7
				October			
	11	17 32 35,0	50,35	91,37	б	9	5*
	13	01 33 10	48,5	93,9	А	9	10
	16	03 29 37,9	50,28	91,45	б	9	5*
	18	13 45 54	48,9	89,6	А	9	11
	22	01 02 52	45,7	91,9	А	9	11
	23	19 40 14,3	51,85	98,63	б	10	3
	26	18 43 30,0	46,17	96,95	б	9	11
	27	15 05 27,0	48,20	84,37	б	9	15
	29	16 59 41,0	51,09	92,98	б	10	16
		17 37 44,0	49,07	98,87	б	9	8
				November			
	2	18 56 44	47,92	84,10	б	10	15
20	4	16 16 31	52,53	98,72	б	11	4
	16	09 47 22,0	50,23	91,35	б	10	1–10*
		14 52 46,0	49,07	98,55	а	9	8
	21	18 23 08,0	51,28	93,25	б	9	6
	22	22 56 47	48,7	85,7	А	9	15

1	2	3	4	5	6	7	8
				December			
	5	13 39 25,0	49,72	87,70	б	9	1
	6	09 53 49,0	51,90	88,60	б	9	2
		13 07 32	46,6	90,1	А	10	11
		22 07 07,1	49,07	94,95	б	9	8
	10	09 51 12,7	47,70	86,33	б	9	11
	13	03 14 22,6	47,67	90,57	б	9	11
21	16	14 43 55	50,70	97,92	б	11	7
	17	10 13 21	50,4	91,3	А	9	5*
	18	13 00 12,5	51,45	93,45	б	9	6
	22	06 38 37,1	49,35	98,62	а	9	8
	23	08 09 28,8	48,18	92,52	б	9	10
		20 50 45	47,9	80,0	А	9	14
	24	14 57 03,5	48,87	87,57	б	9	11
22	29	14 41 30	44,4	83,2	А	11	24
	30	13 21 30,9	49,35	88,05	б	9	1

* Aftershock on 15 May 1970
** Aftershock on 30 April 1973

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EARTHQUAKES IN THE BAYKAL REGION

S. I. Golenetskiy

Seismic recording in the Baykal and Transbaykal regions in 1973 was carried out by the same network of seismological stations as in 1972. The only change was that in April 1973 the temporary seismological station at Tokhoy, in the Lake Gusin region (Southern Baykal region) was closed. Therefore, for most of the year the observations were made by the remaining 18 stations and the information on the equipment used at these stations and its frequency responses is contained in the surveys of the seismicity of the Baykal region during the preceding years [1-5]. They also describe the methodology for processing the seismic observations [1-4], which were unchanged in 1973, and give the system adopted for breaking the zones up into conditional regions [5].

The energy class of the earthquakes was determined according to Rautian's method [6]. The total number of earthquake epicenters determined in 1973 is approximately the same as in each of the preceding two years (2,623). The parameters of the strongest earthquakes are given in Table 1. The accompanying catalog of earthquakes with $K \geqslant 9$ contains information on 347 epicenters. The epicentral field is shown graphically in Figure 1 (earthquakes with $K \geqslant 9$) and Figure 2 (earthquakes with K=7-8) (see inset).

The distribution of the number of earthquakes with respect to energy is shown in Table 2. Shown here as well are the results of estimating the angular coefficients of the frequency graphs γ, constructed by the method of least squares for the earlier adopted (see preceding surveys of seismicity) division of the region into subzones. In this case the usual difference in these coefficients was revealed for the northeast and southwest parts of the reef zone (a lower angular coefficient for the southwestern part), which does not, however, exceed the possible error in determination.

A rough estimate of the average rate of release of conventional elastic deformations in the Baykal reef zone (from the slope of Benioff's diagram) in 1973 is completely typical for the last few years--10^5 $J^{1/2}$ a day. Despite the similarity of these general seismicity indicators to certain average values for them, however, each year proves to be quite unique with respect to the detailed manifestation of seismicity. In the Baykal region 1973 was a year of clusters of earthquakes in Southern Baykal and in the region of the northeastern part of the Tsipikanskiy basin, where the seismicity in the last few years was low. At the same time, the entire zone (mainly the area of the Baykal reef) continued to live its usual active seismic life, as has been frequently described earlier [1-5]. In order to trace the development of the seismic process in time, monthly work maps were plotted of the epicenters of all the earthquakes and the temporal-spatial chart in a projection to the conditional axis of the Baykal reef system for earthquakes with $K \geqslant 9$ (Fig. 3, for a description of the details of its plotting see the surveys of seismicity in the Baykal region in the preceding years).

Table 1. List of the Strongest Earthquakes in the Baykal Region (K=12)

(1) № п/п	(2) Дата (1973 г.)	(3) Момент возникновения, час, мин, сек	Координаты эпицентра (4)	
			φ°N	λ°E
1	25.I	19 56 48,6	51,68	103,93
2	26.II	05 40 12,3	56,56	117,75
3	28.II	10 17 22,1	53,00	107,83
4	12.IV	08 30 09,5	48,40	102,93
5	10.V	13 46 30,1	54,85	112,56
6	22.V	10 13 37,1	53,23	108,07
7	16.VI*	12 12 26,9	54,85	112,58
8	1.VIII	13 11 35,5	49,45	97,30
9	18.IX	13 56 30,3	53,14	107,75
10	14.X	00 58 19,8	53,45	109,91
11	16.XII	14 43 58,5	50,64	98,07

* K=13.

Key:

1. No, in order
2. Date
3. Moment of occurrence, hrs, mins, secs.
4. Coordinates of epicenter

The activation of seismic activity in the region of the southern end of Baykal began in December 1972, and with respect to the number of earthquakes that occurred proved to be most sizeable in this region throughout the entire operational period of the existing expanded network of seismological stations (beginning in 1962). For example, in the region bounded by the coordinates 51.4-51.9° N lat and 104-105° E long, during 1973 155 jolts were recorded, including one with K=11 and 3 with K=10. From the beginning of the year the number of jolts gradually increased, and was maximal in March (80) and then diminished; in the last few months of 1973 only individual weak earthquakes were recorded. The greatest activation of this cluster was observed from 21 February to 5 March and from 16 March through April. It is interesting that the epicenter of the strongest earthquake, with K=12, felt on 25 January at 19:00 at distances of over 100 km, proved to be shifted to the west in relation to the indicated area of concentration of the jolts. Another special feature of this earthquake was the complete absence of any jolts in the vicinities of this epicenter in the preceding and following weeks. Therefore, the impression is created that in Southern Baykal there were two different significant events--the strongest the single jolt of the 12th class and the cluster of quite numerous earthquakes, the maximal one of which is in the 11th energy class.

In the fact that the 12th class earthquake was not accompanied by weaker jolts may be evidence of a certain analogy to the stronger earthquake of the 14th class, which occurred on 30 August 1966 [7], when there were also essentially no aftershocks or foreshocks. The epicenter of this earthquake was located, however, somewhat to the east, approximately in the location in which the above-mentioned considerable cluster of earthquakes was observed.

Table 2. Distribution of Earthquakes in Baykal Region by Energy Classes

K	(1) Вся зона	(2) Рифт	Северо-восточная часть рифта (3)	Юго-западная часть рифта (4)
13	1	1	1	–
12	10	7	3	4
11	26	15	10	5
10	70	40	32	8
9	240	167	116	51
8	730	533	338	195
7	1172	1020	755	265
6	350	348	300	48
5	22	22	20	2
4	2	2	2	–
Всего (5)	2623	2155	1577	578
γ	$-0{,}47\pm0{,}01$	$-0{,}48\pm0{,}03$	$-0{,}52\pm0{,}01$	$-0{,}44\pm0{,}08$

Key:
1. Entire zone
2. Reef
3. Northeastern part of reef
4. Southwestern part of reef
5. Total

When describing the tectonic conditions of the localization of these earthquakes, it should be mentioned that the main elements of the fault tectonics in the region under discussion are the large zones of the Obruchev and Cherskiy faults [8-10]. The first of these faults is defined by the outlines of the northern shore of Baykal and is expressed as a steep underwater bench (to depths in the order of 1400 meters), which originated, apparently, with the shift of the large block of the crystalline base of the basin along a single fault plane. The Obrucheva fault occurred as early as the Precambrian period and then underwent repeated regenerations. The maximal amplitudes of the neotectonic movements along the Obrucheva fault are similar to those along the Cherskiy fault and are quite sizeable (they exceed 5-6 km).

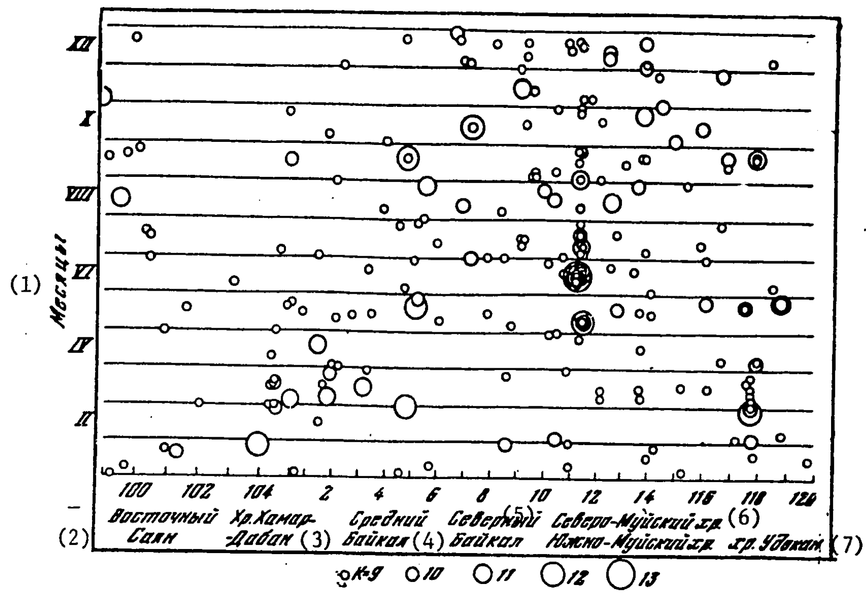

Figure 3. Distribution of Earthquakes in 1973 in Time (in a Projection for the Conditional Axis of the Baykal Reef System)

Key:

1. Months
2. Eastern Sayan
3. Khamar-Daban Ridge
4. Central Baykal
5. Northern Baykal
6. Northern Muyskiy Range--Southern Muyskiy Range
7. Udakan Range

The structure of the Cherskiy fault zone is considerably more complex, and is less clearly singled out. The fault is characterized by a complex stepped-echelon structure with visible amplitudes of fault scarps of tens and hundreds of meters, and passes along the bottom of the lake at a distance apparently somewhat less than 10 kilometers from the shore. The southern slope of the lake basin is substantially more gentle than the northern, and more rugged. In many places here transverse and diagonal fanning faults are noted with a visible amplitude of the vertical shift being 100-500 meters. In the section between the Snezhnaya and Pereyemnaya rivers they form transverse and diagonal horst- and grabenlike structures. In comparison with the Obrucheva fault, the Cherskiy fault is more fragmented, and often breaks up into parallel branches. At the southwest end of the Baykal basin, the Obrucheva and Cherskiy faults connect and intersect. In this case the tapering out of the Obrucheva fault is observed, with its breaking up into a series of steplike faults with varying amplitude (700-1200 meters).

Table 3. Dynamic Parameters of the Mechanism of Earthquake Focal Points

(1) Дата и время	(2) Плоскость разрыва I				(6) Плоскость разрыва II			
	A_z^o	e^o	Компоненты подвижки (3)		A_z^o	e^o	Компоненты подвижки (3)	
			по простиранию (4)	по падению (5)			по простиранию (4)	по падению (5)
25.I 19 час (7) 56 мин (8)	12	60SE	+1,00	0,00	102	90	–0,866	0,500
16.VI 12 час 12 мин	14	44NW	+0,515	–0,857	54	54SE	–0,438	–0,899

(9) *Окончание*

(1) Дата и время	(10) Напряжение					
	сжатия (11)		промежуточное (12)		растяжения (13)	
	A_z^o	e^o	A_z^o	e^o	A_z^o	e^o
25.I 19 час 56 мин	53	21	282	60	151	21
16.VI 12 час 12 мин	201	68	38	22	306	6

Key:

1. Date and time
2. Fault Plane I
3. Shift components
4. Along the strike
5. Along the dip
6. Fault plane II
7. Hrs
8. Mins
9. Conclusion
10. Stress
11. Compression
12. Interstitial
13. Strain

The epicenter of the strongest earthquake on 25 January 1973 was located in the region of the western closure of the Lake Baykal basin. It may be that its focus is related to the zone of the Cherskiy fault, but it is also impossible to rule out the possibility of its connection with the Obrucheva fault, since the zones of the faults in this region are quite similar and the epicenter is located with an error of at least several kilometers. According to the results of determining the focal mechanism of this earthquake, carried out by N. V. Solonenko (Table 3), the most probable vertical fault plane has an almost latitudinal (east-southeast) strike, and the stress-strain tensions run almost horizontally.

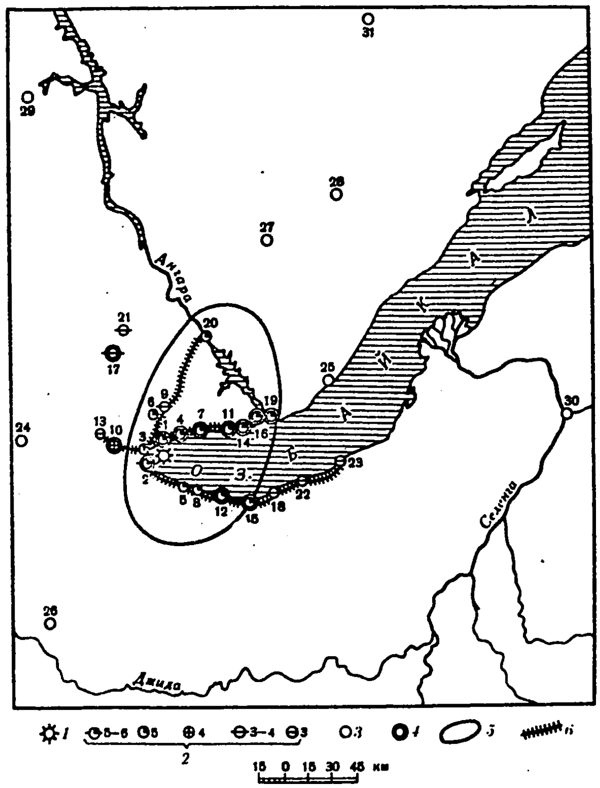

Figure 4. Macroseismic Manifestations of the Earthquake on 25 January in Southern Baykal

1--instrument epicenter of earthquake; 2--intensity; 3--not felt; 4--centers where a rumble was heard during the earthquake; 5--isoseismal lines; 6--traverse routes of investigation

The earthquake on 25 January was felt in the Baykal region over a large area. A map of its macroseismic manifestations is given in Figure 4. A. D. Abalakov, V. A. Avdeyev, L. V. Anisimova, A. A. Vtorushin, M. G. Dem'yanovich, V. I. Dzhurik, P. Ya. Zelenkov, S. V. Lastochkin, G. N. Maslennikov, F. V. Novomeyskaya. V. A. Pavlenov, V. A. Potapov and G. Ye. Serova, associates of the Institute of the Earth's Crust of the Siberian Department of the USSR Academy of Sciences, participated in the compilation of the macroseismic information.

M. G. Dem'yanovich and A. D. Abalakov performed the macroseismic study of the population centers on the shore of Baykal from Slyudyanki to the Mishikha aquatic station and along the Tunkinskiy channel to the perceptibility boundary.

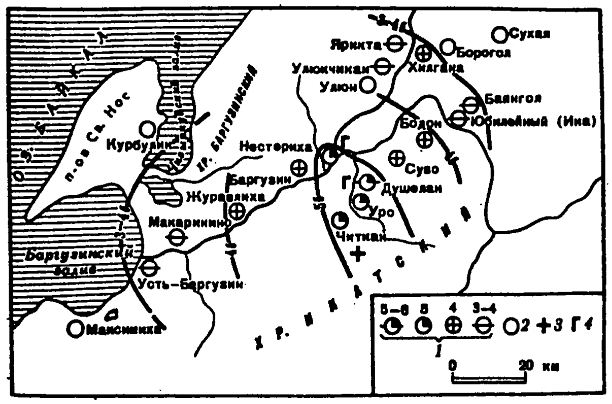

Figure 5. Pattern of Isoseismal Lines of Earthquake on 14 October. Drawn Up by A. D. Abalakov and P. Ya. Zelenkov

1--intensity; 2--not felt; 3--epicenter according to instrument data; 4--centers at which rumble was heard

Reporters' information was also gathered from 15 population centers. The summary of the materials gathered was made by V. S. Khromovskiy. According to this data, the strongest shock encompassed the strip of the coast of Southern Baykal. At the large population centers Nos 2 and 8--Slyudyanka (14 km) and Baykal'ska* (28 km)--in some areas shocks were observed with a magnitude up to 6 points. Before the jolt a rumble was heard from the direction of Baykal. When large buildings were examined after the earthquake, many hairline cracks were revealed, from 0.5 to 1.5 meters long, with a opening up to 2-3 mm in the plaster of the walls and ceilings. Plaster crumbled from newly formed and uncovered old cracks. Many inhabitants noticed the vibration of walls and ceilings. There are reports of furniture shifting and objects falling from shelves and tables. Most of the inhabitants were awakened by the jolts, and some were frightened.

Atypically weak vibrations were felt in shops, quarries and service facilities. Here the jolts were felt only by those who were not moving around. It may be noted that this atypical decay of the shocks was also observed in the weak Slyudyanska earthquake in October 1965.

The shock was felt with an intensity of 5 points at the port of Baykal (No 16, 63 km), at the sources of the Angara (No 19, 70 km), in the village of Ulanovo (No 14, 48 km), at a railway siding of 102 km (No 11, 43 km), at the settlement of Marituy (No 7, 28 km), the village of Shibertuy (No 4, 16 km), the settlements of Sharyzhalgay (No 1, 10 km), Kultuk (No 3, 15 km), Solzan (No 5, 21 km), Murino (No 12, 43 km), Bydrino (No 15, 60 km) and Bol'shaya Glubokaya (No 6, 27 km).

* V. Sh Sharapov and M. V. Manzheyev, associates of the Eastern-Siberian Engineering Construction Research Trust, made a detailed examination of Baykal'ska.

Table 4. Aftershocks of Strong Earthquakes in the Baykal Region

Землетрясение (1)	(2) Район	Число афтершоков (3)	K_{max}
(4) Тас-Юряхское, 1967 г.	56.2–56,8° с.ш.,(8) 120,5–121,5° в.д.(9)	57	11
(5) Моготское, 1967 г.	47,9–48,8° с.ш., 102,5–103,5° в.д.,	71	12
(6) Муйское, 1957 г.	56,0–56,3° с.ш., 116,1–117,0° в.д.	55	10
(7) Кодарское, 1970 г.	56,6–57,0° с.ш., 117,5–118,0° в.д.	38	10

Key:

1. Earthquake
2. Region
3. Number of aftershocks
4. Tas-Yuryakhskoye, 1967
5. Mogotskoye, 1967
6. Muyskoye, 1957
7. Kodarskoye, 1970
8. N lat
9. E long

Many inhabitants in these centers were awakened during the earthquake and noticed the vibration of the walls, hanging objects and furniture, and here and there some objects fell. In many cases it seemed as if two shocks occurred and a rumble was heard (Sharyzhalgay, Slyudyanka, Shibertuy, Marituy, etc.) sometimes very strong (at the Bol'shaya Glubokaya Station--"horrible").

Reports were received from a number of centers concerning the fright of the inhabitants (Marituy, Shibertuy, Sharyzhalgay, Ulanovo, the port of Baykal, Vydrino). Sometimes the plaster crumbled (Marituy, the source of the Angara), and at Kultuka the appearance of new small hairline cracks and expansion of old ones was noticed in the plaster.

Outside the limits of the epicentral zone the most complete macroseismic information on the earthquake was gathered in various regions of the Irkutsk River, where (at the greatest distance from the epicenter) a 5-point effect was also noted. At the moment of the jolt, most of the inhabitants in the city of Irkutsk (No 20, 76 km) awoke. Many people on the upper floors of the building were frightened. The rattling of dishes and glasses was noted everywhere. In some cases hairline cracks appeared in the plaster of the walls. At the Bystraya center (No 10, 33 km), the earthquake was felt with an intensity of 4 points and a rumble was heard. At centers Nos 9, 17 and 21--Podkamennaya (30 km), Tal'yany (65 km; a rumble was heard), and Yagaty (78 km)--3-4-point vibrations were felt. The earthquake was felt with an intensity of 3 points at centers No 13, 18, 22, 23--Tibel'ti (45 km), Kedrovaya (70 km), Tankhoy (87 km), Mishikha (110 km). At centers Nos 24-31--Tunka, Bol'shoye Goloustnoye, Sanaga, Ust'Orda, Baynday, Zapari, Ulan-Udz, Kachug--the earthquake was not felt.

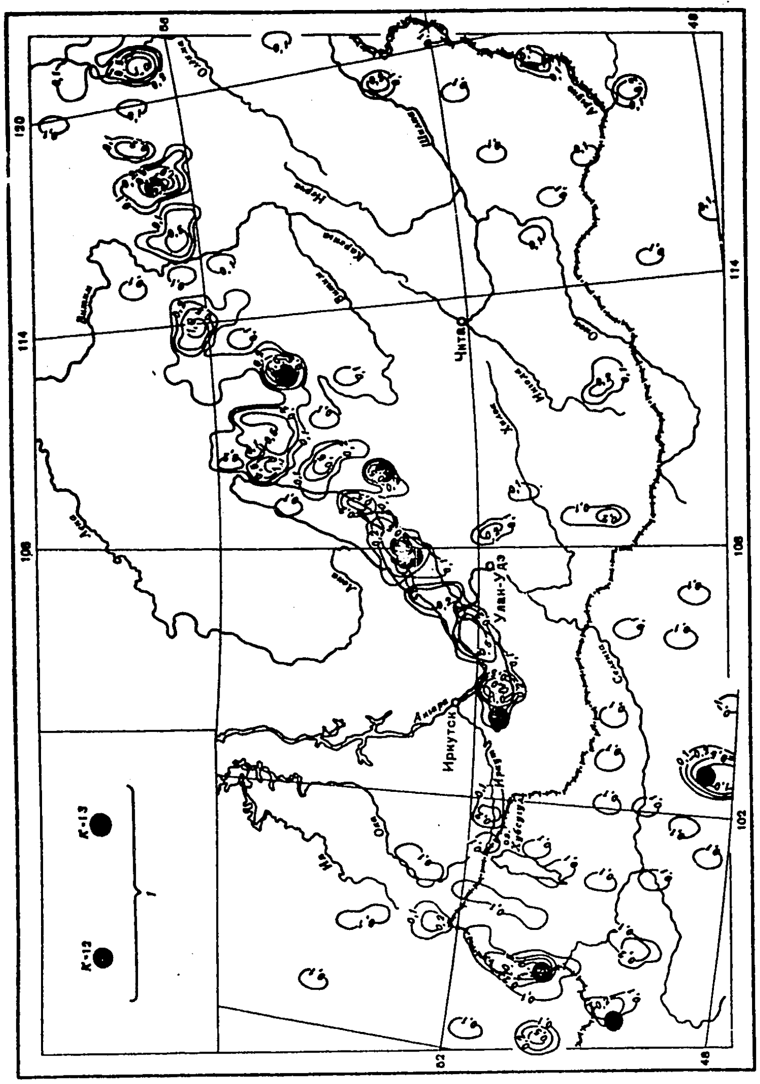

Figure 6. Map of the Seismic Activity of the Baykal Region (in Isolines A_{10})

1--energy of earthquakes

Only the 5-point isoseismal line can be marked out from the information gathered. It stretches out somewhat in the meridional direction, which makes it possible to see a certain analogy with the known isoseismal lines of the earthquakes in Southern Baykal in 1902 and 1912 [10]. The picture obtained is not in accordance with the latitudinal isoseismal lines of the highest points plotted for the preceding strong earthquake on 30 August 1966 [7]. The isoseismal lines with a lower intensity in this case too, however, noticeably expand in a northern direction from the epicenter.

The aggregate of weaker earthquakes in Southern Baykal described earlier occupy a somewhat more easterly region of the water area and coastal area of Lake Baykal. In this case the majority of the epicenters are located in the southern part of Baykal and, apparently, are caused by the activation of the zone of the Cherskiy fault (with all the complex interweaving of the derivatives of the faults of a higher order).

In March, when the most noted cluster of earthquakes appeared in Southern Baykal, a certain activation was observed in the western regions of the Central Baykal as well (some earthquakes with K=10-11). From May to October the number of earthquakes in the Baykal region noticeably increased even farther to the northeast, to the east and south from Ol'khon Island. An earthquake with K=12 was recorded here at the end of February, in May and in the middle of September. Therefore, three earthquakes with K=12 were recorded in a relatively small area during the year.

The most important event in May, however, was the development of a cluster of earthquakes in the region of the northeastern part of the Tsipikanskiy basin and the mountain ridge separating it from the Bauntovskiy basin. Small groups of weak jolts occurred here as early as January, and after that, in April.

The onset of the first period of considerable seismic activation, in which 13 earthquakes, occurred, the strongest of which was K=12, was from 10-13 May. The greatest magnitude of the process was achieved, however, in the period after 16 June, when the strongest earthquake in the cluster and in general in the Baykal region in 1973 occurred (K=13, M=5.1). The epicenter of this earthquake essentially coincides with the epicenter of the preceding jolt of 12th-class energy. Up to the end of the year, the activity, in diminishing, was manifested quite uniformly, if one does not take into account the fact that in August there were noticeably fewer earthquakes. A total of 317 earthquakes were registered during the year in the region bounded by the coordinates 54.7-55.2° N lat, 112.4-113.1° E long. The slope of the frequency graph γ , plotted from 130 jolts, is approximately equal to 0.45 and corresponds to that obtained earlier in work [11]. This cluster was the greatest in the Baykal region, and nothing of its kind was observed earlier in this region (neither the earthquakes with K=13 and even with K=12, nor such intensive reactivation of the seismicity). Throughout the period of instrument registration here a total of several dozen weak earthquakes was recorded.

The epicentral region of the earthquakes in 1973 encompasses the northeastern half of the Tsipikanskiy basin and the central part adjacent to it (northeast of Lake Kapýlyushi), of quite a broad mountain ridge between the Tsipikanskiy and Bauntovskiy (rather, Upper-Tsipinskiy) basins. The only epicenters (the possibility is not excluded that this is due to an error in determining them) fall in the northeastern higher areas of this ridge, as well as within the limits of the Upper-Tsipinskiy basin.

The increased seismicity of the mountain ridges between the basins in the northeastern part of the Baykal reef zone in general constitute a known conformance to principle. The Bauntovskiy basins, however (particularly with the inclusion in the general discussion of the Tsipikanskiy basin) occupy a somewhat special position, since they are located in the zone of transition from the Baykal reef system to the area of the Transbaykal block uplift (Vitimskoye plateau) and differ from the typically Baykal basins in a number of features [11, 12]. As a rule they do not have clearly marked outlines on the plane, their connection with the mountain setting is irregular and the transitions to the edges are smooth, without sharp benches. The tectonic development of these basins proceeds slowly. They apparently emerged onto the path of development of the reef structures in the Holocene epoch.

Along the sides of the Tsipikanskiy basin, just as on the mountain ridge, separating it from the Upper Tsipinskiy basin, Holocene faults of a northeastern strike are known [11]. Paleoseismodislocation has been established in the region of the northeastern part of the ridge [12].

The considerable swarm of earthquakes in 1973 being described was located on the line between the epicentral areas of a known large swarm in the central part of the Ikatskiy Range [11] and a series of earthquakes in 1968-1970 in the region of the Busansko-Filinskiy ridge in the Bauntovskiy basin [11]. The seismic activity is thus established of the mountain ridge between the Tsipikanskiy and Upper-Tsipinskiy basins and the presence of a single seismic belt passing through the Bauntovskiy and Tsipikanskiy basins to the Ikatskiy Range is confirmed. With respect to its seismic potential, the Tsipikanskiy basin appears to be comparable with the Bauntovskiy. The analogy between the events of 1973 and of 1968-1969 is traced not only to the similarity in the swarms, but also to the parameters of the strongest jolts. In both cases, on 21 July 1968 and on 16 June 1973, the magnitudes of the earthquakes were 5.1. While for the second one of these jolts, fault plane II is considered the actual one (from the northeast strike and dip to the southwest) (see Table 3), a correspondence is detected with the results of the selection of the fault plane in the earthquake on 21 July 1968 [2, 3]. The orientation of the axes of the stresses for the 1973 jolt was the usual one for the Baykal reef area (tensile stress horizontal and directed transversely to the structures and compression stress close to vertical). The earthquake on 21 July 1968 was felt only weakly even at small distances (in the order of 35 km) [13]. The jolt on 16 June 1973, at a similar distance (settlement of Verkhniy Tsipikan) was not felt at all.

In all the reports obtained from correspondents from the 12 regions surrounding the epicenter (true, very sparsely populated) there was no information on the perceptibility of the earthquake.

A perceptible, but less numerous compared with the above-described, cluster of weak earthquakes occurred on 7-18 July 1973 in the northern part of the Barguzinskiy Range. In the region bounded by the coordinates 55.0-55.2° N, 110.0-110.35° E, 27 earthquakes were recorded in this period, of which the strongest were 3 with K=9. It must be noted that the clusters here were observed repeatedly: at the end of June to July 1969 over 20 jolts were recorded, the 3 strongest of which were in the 10th energy class [11]; in May 1971 over 50 jolts occurred with the maximum earthquake in the 11th energy class, and in October-November 1971 a weaker outburst of activity was observed [5]. The epicentral regions of these clusters were confined to the area in the Barguzinskiy Range where the Tompuda River forms a right angle, changing the direction of its course from meridional to latitudinal.

The tectonic situation in the part of the Barguzinskiy Range being discussed is represented in various publications [8, 14-16] differently: sometimes the fragmentary zone of short ancient faults, cutting the Barguzinskiy Range obliquely in the direction toward the Upper Angara basin from the coastal region of Northern Baykal (the region south from the Kaban'ya River) is depicted, and sometimes note is made in this zone of a single extended fault or no fault at all is mentioned. The seismic observations, apparently, indicate the presence here of a seismically active belt [17], i.e., the increased mobility of this zone. The clusters of earthquakes discussed gravitate toward this precise belt.

In August the region of the cluster was seismically quiescent, but in September the seismicity was moderately revived 20-30 kilometers to the east, in the region of the interior field of the Barguzinskiy Range.

The most noticeable event in October was an earthquake with M=5 near the southwest end of the Bartuzinskiy basin, accompanied by a small number of aftershocks (about 15). The earthquakes here are quite rare (a few weak jolts a year), but still, quite strong jolts are also known: with M=5.5 in 1949, with K=12 in 1968 (in the region of the low mountain ridge--the Shamanskiy crest, separating the Bartuzinskiy and the Ust'-Bartuzinskiy basins).

A. D. Abalakov and P. Ya. Zelenkov made an examination of the effects of this earthquake on 14 October. The map of the isoseismal lines drawn up according to the results of this examination is given in Figure 5. The earthquake encompassed the area of the northwestern slopes of the Ikatskiy Range and the adjacent parts of the Barguzinskiy basin. The greatest intensities (5-6 points) of the shock were reached in the settlement of Dushelan (No 3, 18 km). The strongest first jolt was accompanied by a strong low rumble, which came from the direction of the Ikatskiy Range. The cleaving of log huts that were shaken was heard, and frightened people ran from them.

In almost all the houses the plaster crumbled, and small cracks appeared in the ovens. A pile of timber lying on the outskirts of the settlement shook, and a few logs were knocked down. The vibrations of the soil were felt by people who were outdoors.

The intensity of the seismic manifestations in Dushelan, as compared with the centers located close to the epicenter, however, may possibly have been caused by the unfavorable geological engineering local conditions. Most of the structures here were built on sandy-clayey soils with the level of ground waters shallow (1-2 m). An earthquake with an intensity of 5 points was felt at Chitkan (No 1, 9 km), Uro (No 2, 12 km), Nesterikha (No 4, 25 km); with an intensity of 4 points--at Suvo (No 5, 26 km), Barguzin (No 6, 26 km), Bodon (No 7, 33 km), Zhuravlikhe (No 8, 33 km), Ulyun (No 9, 42 km), Khilgana (No 14, 53 km); with an intensity of 3-4 points--at Yubileynyy (No 10, 43 km), Ulyukchikan (No 11, 48 km), Bayangol (No 12, 48 km), Makarinino (No 13, 48 km), Yarikta (No 15, 54 km), Ust'-Barguzin (No 16, 55 km). In the settlements of Borogol, Kurbulik, Sukhaya and Maksimikha the earthquake was not felt. A rumble was heard in the settlement of Nesterikha.

The seismic activity of the region at the southwest end of the Charskiy basin and the adjacent parts of the anticlinal-block uplift of the Udokan Range should also be mentioned. The seismicity of these regions is known [1, 11, 18, 19], but no earthquakes of the 12th energy class were recorded here in the entire period of instrument observations. An earthquake with K=12 was registered in this region in February.

In general in the Baykal region in 1973 a relatively large number of earthquakes of the 12th energy class occurred.

Just as before, the epicentral regions of the strong earthquakes of preceding years were active (Table 4). The data from the table confirms the conclusion on the stabilization of the seismic process in these areas that was made in the survey of the seismicity of the Baykal region during the preceding year.*

Just as before, in 1973 few earthquakes (less than 20) occurred in the active local area of the central part of the Ikatskiy Range [4, 11, 18]. Consequently, there is all the more reason to refer to the period of former activation as the manifestation of a long-lived cluster of earthquakes quite unique for the Baykal region. The special features of the seismicity that were described were reflected in drawing up the map of the seismic activity (Fig. 6) for earthquakes with $K \geqslant 9$ using the method of a constant degree of detail with areas of averaging 0.4 x 0.4° and their covering at 0.2°. The value of the angular coefficient of the frequency graph was taken as 0.5.

*See [Zemletryaseniya v SSSR v 1972 godu" [Earthquakes in the USSR in 1972], Moscow, Nauka, 1976.

In the area of the Tsipikanskiy-Upper-Tsipinskiy basin, the activity A_{10} reached a value of 5, in Southern Baykal and in the region of the Charskiy basin-Udokan Range--2, and in the regions of the aftershocks of the Tas-Yuryakhskiy and Mogotskiy earthquakes, as well as of the cluster in the northern part of the Barguzinskiy Range--1. Similar activity was recorded in the region of the mountain ridge between the Upper Angarskiy and Muyskiy basins and in the boundary area between Eastern Tuva and Mongolia, which is quite natural, since these areas are among the most seismic in the zone. In the region of the southwestern end of the Barguzinskiy basin, in Central Baykal, between Ol'khon Island and the Svyatoy Nos Peninsula, west of the delta of the Selengi River, as well as in the regions of the eastern part of the Kuandinskiy basin, between the Severo-Muyskiy, Yuzhno-Muyskiy and Barguzinskiy ranges and in the Barguzinskiy Range proper, the activity was characterized by a value of 0.5. There was a very poor constant degree of detail on these maps reflecting the seismic activity of Transbaykal, where only single dissociated earthquakes earthquakes occur over a large area. The seismicity is overstated where these earthquakes occurred in the course of the given year, and is in no way estimated when there were no jolts (even though they occurred from time to time in the past). The period of observations in one year for the accumulation of data is insufficient and, possibly, better results will be obtained from an estimate of the activity using the method of constant accuracy [4].

It must be noted that in drawing up the maps of the activity from materials from observations of the earthquakes in the course of a single year, it is not always possible to obtain a sufficient number of earthquakes on the averaging area to determine the amount of seismic activity with sufficient accuracy. Therefore, using the method of constant detailization, just as the method of constant accuracy, is justified, in essence, in seismically active zones. When seismic activity is determined from a small amount of data, greatly averaged values are obtained for the activity for large areas and the accuracy of their determination is low.

The results of the combined processing of seismic observations of the network of seismological stations in the Baykal region served mainly as the materials for this survey of the seismicity. This processing was done in the Laboratory of Regional Seismicity of the Institute of the Earth's Crust of the Siberian Department of the USSR Academy of Sciences. K. I. Bukina, L. V. Anisimova, L. I. Belova, G. N. Vtorushina, L. P. Vinogradova, N. I. Dorogokupets, G. L. Myl'nikova, G. I. Perevalova, E. A. Tret'yak and Ye. V. Fomina participated in the work.

Catalog of Earthquakes in the Baykal Region With K $\geqslant$ 9 in 1973

№ п/п	Число	Момент возникновения, час, мин, сек	Координаты эпицентра φ^{o}N	λ^{o}E	Класс точности	K	№ района	Макросейсмические данные
1	2	3	4	5	6	7	8	9

Key:

1. Number, in order
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ°N
5. Coordinates of epicenter: λ°E
6. Accuracy Class
7. K
8. Number of region
9. Macroseismic data

January

	1	21 31 55,6	52,45	99,17	б	9	1	
	3	16 12 06,6	53,09	107,47	б	9	8	
		22 47 52,0	57,34	121,41	A	9	20	
	4	19 33 10,3	51,70	104,90	б	9	5	
	5	16 14 15,6	50,96	97,79	A	11	2	
	6	04 23 18,2	56,33	116,20	б	9	19	
		12 49 06,5	51,71	99,70	б	9	2	
		22 41 35,6	52,85	119,21	A	10	18	
	8	20 13 14,9	55,56	111,38	б	9	13	
	10	05 02 59,1	53,36	108,38	б	9	8	
		10 47 52,6	48,31	102,82	A	10	7	
		12 45 32,3	49,88	102,11	б	10	2	
	11	11 40 30,9	49,14	118,14	A	10	22	
	15	05 57 05,0	52,52	98,66	A	9	2	
		18 19 43,4	50,55	108,60	б	11	10	
	16	02 12 08,4	56,72	119,82	б	9	20	
	19	18 07 27,9	48,64	101,64	A	10	2	
	20	14 50 31,2	56,15	113,93	б	9	15	
	21	12 59 07,6	51,64	101,43	б	10	4	
	22	03 35 25,1	56,83	117,85	б	9	20	
		14 21 13,2	48,05	102,65	A	9	7	
	23	12 17 36,2	50,99	100,93	б	9	2	
		22 35 52,0	53,00	119,56	A	9	21	
	24	05 04 52,6	49,22	102,02	A	9	2	
		19 05 49,6	56,23	114,33	a	9	15	
1	25	19 56 48,6	51,68	103,93	б	12	5	See text, Fig. 4
	26	03 52 59,4	58,98	101,22	A	10	3	
	28	07 41 38,0	54,58	110,08	б	10	14	
	29	02 03 13,2	50,75	98,27	A	10	2	
		03 10 36,9	48,00	103,07	A	10	7	
		04 33 06,6	50,72	98,20	A	10	2	
		17 36 12,6	50,77	98,16	A	10	2	
	31	15 12 13,2	50,81	98,21	A	9	2	
		18 17 36,6	56,55	121,02	A	9	20	
		22 59 39,7	55,37	111,44	б	9	14	

1	2	3	4	5	6	7	8	9
				February				
	1	02 58 47,4	56,69	117,26	a	9	20	
		06 57 16,7	56,92	117,77	б	10	20	
		20 12 34,0	55,0	111,48	a	10	14	
	4	21 14 15,3	48,31	102,96	A	9	7	
	5	22 15 18,0	51,77	118,94	A	9	18	
	7	05 09 09,7	49,55	99,14	A	9	2	
	9	04 22 21,5	48,27	102,63	A	9	7	
	13	16 37 26,1	50,28	98,35	A	9	2	
	15	16 16 17,8	52,01	105,51	б	9	5	
	21	08 03 39,4	50,58	116,16	A	9	18	Possibly of non-seismic origin
	25	16 32 55,1	56,56	121,00	б	9	20	
2	26	05 40 12,3	56,56	117,75	б	12	20	
		18 06 26,5	51,57	104,53	б	10	5	
	27	03 34 25,2	51,71	104,38	б	9	5	
		13 56 48,5	51,61	104,47	б	9	5	
		22 49 17,8	51,71	102,06	б	9	4	
	28	03 59 17,3	56,57	117,83	б	10	20	
3		10 17 22,1	53,00	107,83	б	12	8	
				March				
	1	21 08 34,4	56,56	117,75	б	9	20	
	3	04 02 27,9	48,08	102,73	A	11	7	
		06 34 18,7	51,73	104,70	б	11	5	Felt in Irkutsk by some people
		14 46 17,0	49,12	98,87	A	9	2	
	5	04 25 50,5	48,06	102,95	A	9	7	
	6	04 51 11,9	56,49	117,76	б	9	20	
		22 57 35,9	51,88	120,37	A	9	18	
	7	00 26 52,0	55,45	114,40	б	9	16	
		10 46 04,7	52,01	105,66	б	11	5	Same
		13 51 27,0	56,10	112,16	б	9	13	
	12	17 47 19,9	48,49	103,07	A	10	7	
		18 50 50,2	56,53	117,72	a	9	20	
	13	08 48 27,6	51,32	117,28	A	10	18	
	14	11 46 56,1	56,10	112,11	б	9	13	
	15	01 45 35,0	56,27	113,47	б	9	15	
		04 01 02,7	52,03	105,60	б	9	5	
		09 29 33,4	56,57	117,74	б	9	20	
		20 11 37,3	49,77	106,14	A	9	7	
	16	20 23 16,6	56,31	116,21	a	9	19	
		23 26 31,5	51,68	104,44	б	9	5	
		23 46 32,5	52,77	106,54	б	11	8	Felt in Tyrgana up to 4 points, Oymure, Sukhoy
	17	22 39 44,3	51,64	104,47	б	10	5	
	18	04 51 53,7	56,24	115,35	б	9	19	
		12 49 14,7	49,09	100,44	A	9	2	
		18 22 40,9	51,61	104,43	б	9	5	
	19	11 21 08,0	48,48	103,06	A	9	7	
	20	02 10 20,8	51,62	104,51	б	9	5	
		10 53 42,9	49,94	100,36	A	9	2	
	21	12 55 31,8	50,76	98,16	A	11	2	
	22	01 26 05,0	56,30	117,67	б	9	20	

1	2	3	4	5	6	7	8	9
	23	07 17 00,4	48,41	102,80	A	10	7	
		15 33 13,4	56,84	121,68	A	9	20	
	24	19 36 03,0	49,00	105,89	A	9	7	
	25	05 33 49,8	52,15	105,88	б	10	5	Felt in Irkutsk by some people
		07 04 49,7	56,29	117,72	б	9	20	
	26	03 25 23,6	51,76	96,51	A	9	2	
		10 39 31,2	54,27	110,39	б	9	14	
	28	13 52 44,8	52,81	106,74	б	9	8	
		15 21 47,5	55,94	110,92	б	9	13	
	31	13 25 01,6	52,20	106,08	б	9	8	
				April				
	2	21 34 51,0	52,17	105,80	б	9	5	
	5	03 10 48,4	56,38	117,97	а	10	20	
	7	04 01 22,5	56,37	118,00	а	9	20	
		08 22 45,7	51,67	104,43	б	9	5	
	8	05 23 57,9	48,04	103,00	A	9	7	
		08 52 40,4	56,24	116,75	б	9	19	
	10	13 26 34,8	50,83	98,07	A	10	2	
4	12	08 30 09,5	48,40	102,93	A	12	7	
		10 37 11,7	48,11	104,41	A	9	7	
	14	20 57 02,0	56,55	120,86	A	9	20	
	16	09 17 45,8	47,95	102,99	A	9	7	
	18	01 45 15,6	51,94	105,57	б	11	5	Felt in Irkutsk by some people
	19	23 51 08,2	56,32	113,51	а	9	15	
	22	18 13 36,5	49,98	104,07	б	9	7	
	23	19 00 48,5	54,90	112,63	а	9	16	
	27	02 37 10,1	48,12	103,04	A	9	7	
		22 16 58,7	48,19	103,08	A	10	7	
	28	20 14 22,6	54,97	111,14	б	9	14	
		20 14 41,0	54,94	111,16	б	9	14	
	29	05 05 45,2	51,62	104,52	б	9	5	
		05 54 43,3	49,32	97,75	A	9	2	
		21 08 03,2	55,17	111,32	б	9	14	
		23 05 00,4	51,80	100,87	б	9	4	
				May				
	5	15 23 18,0	54,33	110,49	б	9	14	
		20 23 57,8	49,97	116,95	A	9	18	
	9	12 34 17,0	52,08	106,22	б	9	8	
		15 07 54,9	53,51	108,65	б	9	8	
	10	11 30 14,1	54,88	112,58	а	10	16	
		12 53 37,7	54,89	112,64	а	9	16	
5		13 46 30,1	54,85	112,56	б	12	16	
		13 51 38,4	54,86	112,61	а	9	16	
		14 25 09,3	54,88	112,63	а	10	16	
		17 32 04,7	54,85	112,58	а	9	16	
		18 43 04,1	54,87	112,62	а	10	16	
		19 32 19,5	56,81	120,93	A	9	20	
	12	03 39 59,8	50,11	111,45	б	11	18	
	13	01 14 17,8	52,33	106,49	б	9	8	
		01 43 31,4	52,56	106,89	б	9	8	
		08 18 25,3	54,83	112,66	б	10	16	

1	2	3	4	5	6	7	8	9
	14	03 29 33,5	49,52	97,53	A	9	2	
	15	14 48 05,1	56,54	121,02	б	9	20	
		21 50 49,1	54,55	109,43	б	9	9	
	16	14 41 54,7	51,73	105,29	б	9	5	
		17 25 01,3	56,12	114,17	б	9	15	
	17	09 03 59,4	56,32	113,49	б	9	15	
		15 04 18,6	51,80	101,60	б	9	4	
	19	07 45 03,7	56,16	112,74	б	10	13	
		22 19 49,5	51,79	104,62	б	9	5	
	20	08 22 39,5	51,70	104,72	б	9	5	
	21	02 25 39,6	56,63	121,07	б	9	20	
	22	04 35 45,2	56,33	117,64	б	10	20	
		07 09 52,4	56,32	117,65	a	9	20	
6		10 13 37,1	53,23	108,07	б	12 (~4*)	8	
	26	05 11 45,0	56,63	116,25	б	10	19	
		20 10 12,3	57,00	118,86	б	11	20	
		20 11 23,3	56,96	118,87	б	10	20	
	27	18 30 52,5	48,03	102,93	A	9	7	
				May				
	28	15 06 18,3	48,27	102,69	A	9	7	
		20 28 32,4	53,23	108,09	б	10	8	
		09 40 45,3	50,55	97,64	A	9	2	
				June				
	1	14 39 29,2	53,64	98,68	б	9	1	
		19 19 50,7	56,37	114,19	a	9	15	
	4	11 40 46,1	49,97	108,65	A	9	10	
		17 47 03,6	53,00	107,84	б	9	8	
	5	05 35 30,0	56,71	118,66	a	9	20	
	6	05 25 43,0	48,10	102,66	A	9	7	
	7	03 27 51,0	50,53	96,64	A	9	2	
	8	22 40 50,9	50,00	103,08	б	9	7	
	9	13 20 13,0	51,42	98,22	A	10	2	
		23 11 14,2	51,88	108,39	б	10	10	
	11	17 28 31,7	54,85	112,55	a	9	16	
		22 05 49,9	54,86	112,55	б	9	16	
	14	15 20 34,2	51,03	97,92	A	10	2	
	15	21 31 55,4	48,75	106,93	A	10	7	
7.	16	12 12 26,9	54,85	112,58	б	13 (5,0*, 5,0**)	16	
		12 26 34,5	54,90	112,60	б	10	16	
		15 42 29,4	54,89	112,63	б	9	16	
		23 54 20,1	54,84	112,61	б	10	16	
	17	01 27 28,5	54,90	112,64	б	9	16	
		01 28 17,6	54,85	112,59	б	9	16	
		02 14 38,7	54,89	112,73	б	11	16	
		02 18 47,6	54,86	112,56	б	11	16	
		02 26 12,3	54,81	112,77	б	10	16	
		06 07 16,3	55,16	111,59	б	9	14	
		17 18 32,6	54,83	112,63	б	9	16	
	18	13 59 49,4	56,44	120,90	A	11	20	
		14 25 02,3	54,86	112,55	a	9	16	
		15 02 28,6	56,52	120,79	A	9	20	

1	2	3	4	5	6	7	8	9
	19	07 45 19,6	53,34	98,92	б	9	1	
		10 50 20,0	52,53	106,89	б	9	8	
		12 15 59,7	54,85	112,62	б	9	16	
		12 19 53,5	54,90	112,55	б	9	16	
		14 10 35,0	54,89	112,56	б	10	16	
	20	12 46 02,5	54,92	112,55	б	9	16	
		15 43 39,4	54,86	112,58	б	9	16	
		16 46 05,6	56,34	113,08	б	9	13	
		18 19 40,6	54,88	112,56	б	10	16	
		20 03 46,6	54,86	112,65	б	9	16	
	26	06 04 03,0	49,27	114,45	A	9	22	
		20 58 20,9	55,89	110,32	б	9	13	
	27	02 19 52,4	53,23	107,85	б	9	8	
		06 02 20,4	52,86	100,55	б	9	1	
	28	01 40 55,0	48,09	115,33	A	9	22	
	29	08 12 34,1	53,99	109,27	б	10	8	
		19 33 50,8	54,85	109,02	б	9	9	
	30	00 28 53,3	56,32	116,24	a	9	19	
		18 49 12,1	54,54	109,95	a	9	9	
				July				
	2	01 39 01,0	50,64	96,64	A	9	2	
		09 39 11,0	52,03	105,50	б	9	5	
		18 19 41,2	54,77	111,98	б	9	16	
	3	04 23 13,2	54,86	112,56	a	9	16	
		04 25 26,8	54,85	112,56	a	9	16	
		22 58 44,2	51,22	98,90	б	11	2	
	5	05 35 31,5	51,57	104,69	б	9	5	
		13 54 33,2	56,12	113,87	a	9	15	
	8	00 29 15,3	56,27	121,14	A	9	20	
		04 36 22,9	54,90	112,66	б	11	16	
	9	13 04 10,2	55,13	110,18	б	9	14	
	10	02 36 11,8	54,85	112,59	a	9	16	
	11	13 02 24,6	54,91	112,60	б	9	16	
		13 13 52,1	56,23	116,00	б	9	19	
		14 39 03,1	54,93	112,67	б	9	16	
		19 38 05,8	53,57	108,49	б	9	8	
	13	11 18 36,7	50,11	108,76	A	9	10	
	16	04 24 08,9	55,11	110,26	a	9	14	
		06 32 57,0	55,10	110,22	б	9	14	
		22 43 20,8	50,48	100,47	б	9	2	
	19	04 40 49,6	50,64	100,31	б	9	2	
		20 38 25,0	54,85	112,57	a	10	16	
		21 17 10,5	54,92	112,66	a	9	16	
	20	15 41 55,6	54,91	112,61	a	10	16	
		21 34 43,1	56,41	112,67	a	9	13	
	22	07 25 11,4	56,51	120,88	A	9	20	
	25	16 02 59,4	53,26	107,29	б	9	8	
	28	03 10 27,6	54,29	111,38	б	9	14	
		11 52 09,4	56,18	116,81	б	9	19	
		17 45 32,1	53,06	108,26	б	9	8	
	31	04 11 40,9	53,42	108,03	б	9	8	

1	2	3	4	5	6	7	8	9
				August				
8	1	13 11 35,5	49,45	97,30	А	12	2	
	3	18 17 02,7	54,29	120,98	б	9	21	
	5	20 24 35,9	54,36	110,07	б	9	14	
	8	05 03 54,2	52,95	106,98	б	9	8	
	9	04 37 46,3	47,98	102,89	А	10	7	
		13 36 43,5	54,87	112,71	а	9	16	
	12	18 17 04,0	53,89	109,10	б	10	8	
	13	15 48 23,6	51,25	99,58	б	11	2	
	14	03 04 36,5	55,83	112,90	б	11	15	
		18 14 20,0	50,55	96,55	А	10	2	
	16	05 11 46,3	55,47	110,89	б	10	14	
		11 56 35,7	49,14	118,26	А	9	22	
	17	23 41 53,9	48,33	103,21	А	9	7	
	24	21 43 38,7	55,80	110,31	б	10	13	
	27	09 37 57,4	53,37	108,37	б	11	8	Тырган, 3–4 балла
	28	12 50 55,7	56,32	113,44	б	10	15	
	29	18 18 46,2	48,59	103,23	А	9	7	
	30	04 06 52,8	55,69	115,50	а	9	16	
	31	01 32 03,2	52,21	105,92	б	9	5	
				September				
	1	16 06 48,3	55,15	113,09	б	9	16	
	2	19 54 30,0	49,67	97,42	А	9	2	
		23 17 55,7	54,82	112,64	б	11	16	
	2	23 48 41,2	54,85	112,63	а	9	16	
	3	05 27 58,4	55,17	110,64	а	9	14	
	4	22 09 32,6	55,14	110,63	а	9	14	
	5	19 03 06,4	55,10	110,64	а	9	14	
	7	00 12 51,0	50,62	96,47	А	9	2	
		12 21 22,6	54,12	97,10	А	11	1	
	8	23 36 31,9	53,93	112,36	б	10	17	
		23 57 30,8	55,48	110,93	а	9	14	
	11	10 20 44,0	50,35	119,16	А	9	22	
		10 21 26,0	50,41	119,39	А	10	22	
		11 10 22,0	50,44	119,36	А	10	22	
	12	15 38 49,5	56,26	116,92	б	9	19	
	13	18 12 20,1	55,58	113,56	б	9	16	
	15	09 14 06,3	48,42	102,95	А	10	7	
		12 16 37,5	51,72	104,73	б	10	5	
		22 30 02,1	54,93	112,57	а	9	16	
	16	03 42 32,8	50,94	98,10	б	9	2	
	17	04 01 37,8	49,81	112,18	А	10	18	
		06 40 48,8	51,16	98,06	б	9	2	
		14 46 36,9	56,45	118,0	б	11	20	
	18	04 09 36,9	51,00	99,20	б	9	2	
9		13 56 30,3	53,14	107,75	б	12	8	Тырган, 3 балла
		14 00 01,0	53,26	107,52	б	9	8	
		21 51 57,3	56,55	118,09	б	9	20	
	19	11 14 26,7	56,09	113,86	а	9	15	
		21 55 56,8	56,52	118,06	б	9	20	
	20	07 40 10,0	55,70	114,08	б	9	16	
		12 38 42,6	56,39	116,96	а	10	19	
		13 37 46,1	51,87	99,74	б	9	2	
	21	05 01 37,6	51,24	109,30	А	10	10	Possibly of non-seismic origin

1	2	3	4	5	6	7	8	9
	23	20 50 38,9	52,59	100,11	б	9	1	
	25	04 31 04,7	54,88	112,64	а	9	16	
		06 02 37,2	54,94	112,65	б	9	16	
		08 09 12,1	54,96	112,65	а	9	16	
				October				
	1	08 20 49,9	52,73	107,42	б	9	8	
	2	07 51 28,5	56,52	120,86	А	9	20	
	4	03 23 40,7	57,03	115,08	б	10	12	
	8	22 55 58,8	51,88	105,92	б	9	5	
	10	12 35 26,6	48,13	103,00	А	9	7	
	12	13 25 15,8	48,08	103,18	А	9	7	
	13	14 23 03,1	56,45	116,02	а	10	19	
10	14	00 58 19,8	53,45	109,91	б	12 (4,8**)	14	See text, Fig. 5
		05 55 31,4	53,41	109,83	б	9	14	
	15	09 39 31,9	48,07	102,80	А	9	7	
	16	04 08 04,5	51,77	108,58	б	10	10	
	17	03 51 22,4	55,31	110,00	б	9	14	
	19	03 16 47,8	55,69	112,66	б	9	15	
	22	05 12 56,2	57,54	121,00	А	9	20	
	23	17 16 24,2	56,50	120,82	А	9	20	
		19 40 14,3	51,80	98,75	А	10	2	
	24	18 50 34,3	56,05	113,85	б	11	15	
	25	19 40 30,2	54,87	112,62	б	9	16	
	26	19 40 51,4	51,72	104,72	б	9	5	
	29	02 51 37,4	54,90	112,57	а	9	16	
		17 37 48,5	49,31	98,83	А	9	2	
	30	12 11 31,6	55,29	111,27	а	9	14	
	31	09 30 46,2	56,06	114,52	а	10 11	15	
				November				
	4	16 16 31,6	52,28	98,90	б	11	2	
	6	07 07 05,4	55,05	112,84	б	9	16	
		07 41 54,0	54,91	112,77	б	9	16	
	11	06 29 38,6	54,82	110,80	б	9	14	
	14	16 57 08,5	55,25	110,00	б	11	14	
	24	05 21 05,8	56,21	114,41	а	9	15	
	25	07 45 20,2	56,22	116,80	а	10	19	
	29	19 20 32,6	55,32	109,91	б	9	9	
				December				
	1	06 15 27,2	56,29	113,86	а	10	15	
		12 03 04,1	52,09	106,36	б	9	8	Кабанск, 2–3 балла
	2	20 40 50,4	48,26	101,03	А	9	2	
	3	17 35 45,8	53,41	109,85	б	9	14	
	4	13 41 29,4	56,07	113,76	б	9	15	
		14 59 54,8	49,86	111,75	б	9	18	
		17 04 10,4	57,45	120,77	А	11	20	
	5	08 18 55,2	56,01	118,51	а	9	20	
	6	03 41 28,1	53,39	109,55	б	9	14	
	7	21 01 19,4	55,59	112,84	б	10	15	
	10	20 03 25,5	55,35	110,02	б	9	14	
	14	21 28 18,1	56,10	112,49	а	10	13	

1	2	3	4	5	6	7	8	9
	15	23 42 37,4	57,96	119,89	А	9	12	
	16	14 33 27,3	55,41	111,57	б	9	14	
11		14 43 58,5	50,64	98,07	А	12	2	
	18	16 39 38,4	50,96	115,38	А	9	18	
	19	12 48 03,6	56,50	121,30	А	9	20	
	20	04 14 42,3	54,93	112,61	б	9	16	
		09 40 46,8	53,82	110,41	б	9	14	
	21	17 09 41,4	55,41	111,53	а	9	14	
	22	03 13 06,6	52,78	100,00	а	9	1	
		06 38 39,2	49,39	98,74	А	9	2	
		07 31 18,8	54,89	110,64	б	9	14	
		09 23 23,9	56,28	113,83	б	10	15	
	23	00 35 26,5	54,86	112,56	б	9	16	
		10 11 29,2	53,21	107,69	б	9	8	
		16 38 19,8	53,84	109,00	б	9	8	
	27	04 31 48,4	53,66	109,04	б	10	8	
	28	16 07 54,6	48,04	103,07	А	11	7	

* Designation of magnitude M_L according to surface waves.
** Designation of magnitude m_{PV} SKM according to body waves.

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EARTHQUAKES IN YAKUTIYA AND THE NORTHEAST

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During 1973 similar earthquakes were recorded at 13 points in Yakutiya and the Northeast. A temporary seismological station in the settlement of Batagay began operations at the beginning of the year on the middle course of the Yany River (in the north of Yakutiya). There was a total of 7 permanent and temporary stations in operation in Yakutiya. The network of seismological stations in the Northeast remained unchanged. Information on the permanent instruments at each of the stations is given in Table 1.

The coordinates of the epicenters were determined by the cross bearings in accordance with the transit times of the forward-traveling S-waves with a known rate: for Yakutiya--3.6 km/sec, and for the Northeast--3.5 km/sec [1]. The epicenters of earthquakes with $M \geqslant 4$ were found from the transit times of the forward-traveling and leading P waves. The time at the focus of the earthquake was calculated according to the former method.

Seismogram materials from the network of seismological stations in Yakutiya, the Northeast and the Baykal region were used in processing the instrument observations, as well as the 10-year bulletin of the seismological station at the settlement of Tiksi. The accuracy of determining the coordinates was made in accordance with the Atlas of Earthquakes in the USSR. The epicenters of earthquakes for classes "a" and "b" could be established only for the regions bordering the Baykal zone, and on the remaining territory the class of accuracy was included in "A" and "B."

The focal depth was estimated from the recordings of the station closest to the epicenter ($\Delta \leqslant 50$ km) from the equation of the hyperbolic travel time curve. The energy of the earthquakes was determined from Rautian's scale.

As compared with 1972, the representativeness of the earthquakes remained as before, with the exception of the north of Yakutiya, where, with the appearance of a new observation point at the settlement of Batagay, it proved possible to register, without omissions, earthquakes with $K \geqslant 11$. The lower degree of representativeness of earthquakes for the entire territory being discussed was also equal to $K \geqslant 11$, except for the northeast of Magadanskaya Oblast.

Table 1. Parameters of Seismic Instruments

Станция (1)	Тип аппаратуры (2)	Z		E–W		N–S	
		V_m	T_m	V_m	T_m	V_m	T_m
		(5) Якутия					
(6) Батагай*	СКМ-3 (3)	31 100	0,2–1,1	34 700	0,2–1,1	36 300	0,2–1,1
(7) Усть-Нера	СКМ-3	25 600	0,2–1,0	30 500	0,2–1,0	29 000	0,2–1,0
(8) Усть-Нюкжа	СКМ-3	38 100	0,3–1,2	47 900	0,3–1,2	38 400	0,3–1,2
(9) Хандыга*	СКМ-3	26 300	0,2–0,9	28 200	0,2–0,9	27 900	0,2–1,3
(10) Чагда*	СКМ-3	34 400	0,2–1,1	41 500	0,2–1,1	38 800	0,2–1,1
(11) Чульман	СКМ-3	47 700	0,3–0,9	53 300	0,3–0,9	50 700	0,3–0,9
(12) Якутск	СК	800	0,5–10	1 830	0,4–11	1 900	0,4–11
	СКМ-3	46 500	0,2–1 1	38 900	0,7–1,4	39 200	0,7–1,4
		(13) Северо-Восток					
(14) Магадан	СК	600	1–10	720	1–10	700	1–10
(15) Магадан-1*	СКД (4)	1200	1–17	1 200	1–17	1 200	1–18
	СКМ-3	12 000	0,9–1,2	13 000	0,9–1,2	12 000	0,9–1,2
(16) Омсукчан*	СКМ-3	5 600	0,8–1,2	4 700	0,2–0,6	4 600	0,2–0,6
(17) Сеймчан*	СКД	1 000	1–17	1 000	1–17	1 000	1–17
	СКМ-3	34 400	0,2–0,8	41 500	0,2–0,8	40 800	0,2–0,8
(18) Сусуман*	СКМ-3	19 500	0,6–1,0	19 000	0,6–1,0	20 900	0,6–1,0
(19) Усть-Омчуг*	СКМ-3	19 900	0,6–1,0	18 300	0,2–0,6	18 400	0,2–0,6

(20) * Временные сейсмические станции.

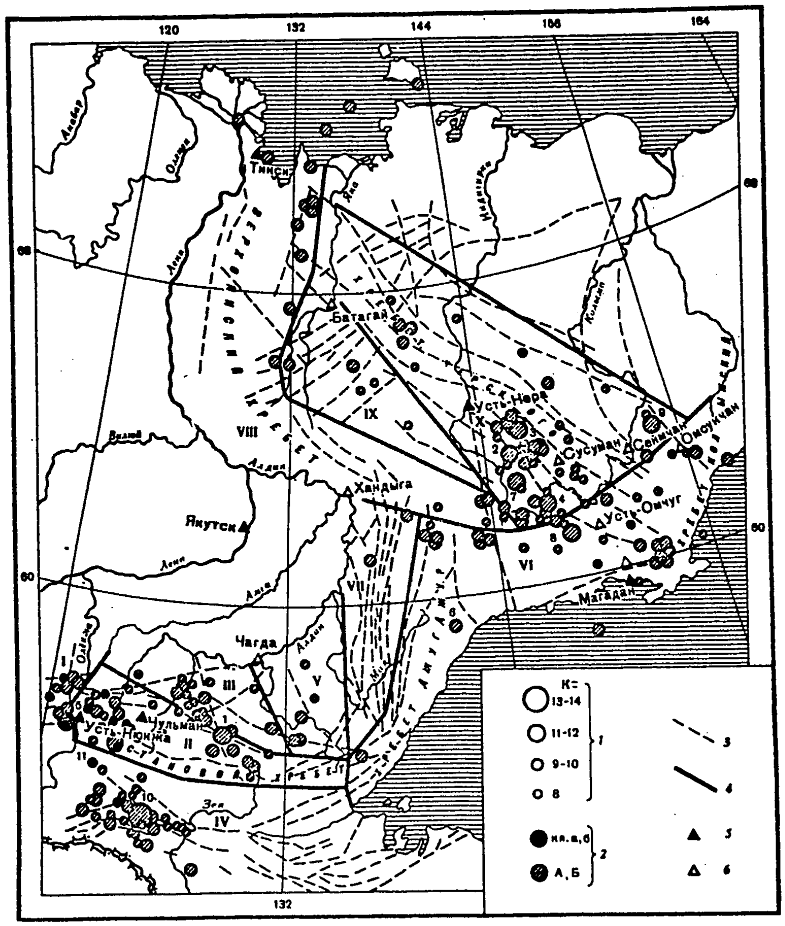
Key:

1. Station
2. Type of equipment
3. SKM-3
4. SKD
5. Yakutiya
6. Batagay
7. Ust'-Nera
8. Ust'-Nyukzha
9. Khandyga
10. Chul'man
11. Chul'man
12. Yakutsk
13. Northeast
14. Magadan
15. Magadan-1
16. Omsukchan
17. Seymchan
18. Susman
19. Ust'-Omchug
20. Temporary seismological stations

The catalog of earthquakes in Yakutiya and the Northeast of the USSR in 1973 contains information on 336 jolts (see diagram).

Just as in the preceding years, the southern regions of Yakutiya were constantly active. Two groups of earthquakes were observed in Olekminskiy Rayon. One of them was located in the area of the Tas-Yuryakhskiy earthquake in 1967. It is possible that these shocks were aftershocks of this jolt. About 30 earthquakes were registered here during the year. Their is no doubt as to their confinement to the Tas-Yuryakhskiy and Imangriyskiy seismogenic faults, included in the system of the Stanovoy structural seam [2]. The epicenters of the earthquakes described have now shifted to the north of the location of the main jolt and fall into the interfluve of the

Imangra and Tas-Yuryakh rivers (basin of the Olekmy River). The second group of jolts consists of the aftershocks of the earthquake on 15 January 1972 which occurred in the Olekmo-Charskiy upland. The values for the focal depths of the earthquakes at Tas-Yuryakh are within a range of 9-22 km.



Map of the Epicenters of Earthquakes in Yakutiya and the Northeast

1--energy of earthquakes; 2--accuracy of determining the epicenter; 3--faults; 4--boundaries of seismoactive regions; 5--permanent seismological stations; 6--temporary stations

Table 2. Macroseismic Data on the Earthquake on 2 November

No, in order	Location	Δ, km	Points	No, in order	Location	Δ, km	Points
1	Yanyr	25	7	23	Ivanovka	90	5
2	Gonzhinskoy party base	35	6	24	Dzheltulak	90	5
3	Dzhuvaskit	45	5-6	25	Bol'shoy Never	95	4
4	Gudachi	60	5	26	Pioner	95	5
5	Komsomol'skiy	60	5	27	Daktuy	100	4
6	Kukushka	60	5	28	Ovsyanka	105	5
7	Obka	60	5	29	Skovorodino	110	4
8	Zolotaya Gora	60	5	30	Zeya	110	5
9	Urkan	65	5	31	Berezovka	115	5
10	Kerek	65	5	32	Tyndinskiy	120	4
11	Gonzha	70	5	33	Dambuki	125	3-4
12	Arbinskiy logging ctr.	70	6	34	Tygda	130	4
				35	Chalbachi	130	4
13	Perevoz-Gilyuy	70	5	36	Dzhalinda	135	3
14	Kamenushka	70	5	37	Ust'-Umlekan	140	4
15	Strelka	75	5	38	Ushumun	165	4
16	Mari	75	4	39	Khayktinskoy party base	170	5
17	Taldan	75	4				
18	Solov'yevsk	80	5	40	Urusha	175	3
19	Magdagachi	85	5	41	Kuznetsovo	180	3-4
20	Kirovskiy	85	4	42	Sivaki	185	3-4
21	Aprel'skiy	85	5	43	Ust'-Urkima	195	2-3
22	Angarich	90	4	44	Bomnak	210	2-3

The increased number of epicenters, as before, is discovered west of the Stanovoy Range, in the zone of the connection of Stanovik and the Zvereva Range. In the region of the Larbinskiy earthquake its repeated jolts continued to be recorded with energy at the focus of 10^7-10^{11} J. The eastern section of the range near Lake Toko was more active. The central part of Stanovik was not very active. The depth of occurrence of the jolts of Stanovoy Range was 12-23 km.

On the Aldanskiy upland, the concentration of the epicentral field occurred on the right bank of the Rimpton River. In this section, after the earthquake recorded here on 9 August 1972, a weakening of the seismic process was observed.

The values of the seismic activity A_{10} for the three regions under discussion on the average slope, γ, of the frequency chart was 0.5 during the period of observations from 1963-1972 without aftershocks and of the groups were 0.083 (Olekminskiy Rayon), 0.029 (Stanovoy Range) and 0.019 (Aldanskiy upland).

Table 3. Distribution of Earthquakes in Yakutiya and the Northeast According to Energy

K	(1) Номер района										Вся зона (2)
	1	2	3	4	5	6	7	8	9	10	
8	32	45	9	26	2	27	2	2	4	61	210
9	8	14	3	8	2	16	1	9	3	21	85
10	2	3	1	4	–	12	–	3	–	5	30
11	1	1	1	–	–	3	–	–	–	3	9
12	–	–	–	–	–	–	–	–	–	1	1
13	–	–	–	–	–	–	–	–	–	–	–
14	–	–	–	1	–	–	–	–	–	–	1
(3)Всего	43	63	14	39	4	58	3	14	7	91	336

Key:
1. Number of region
2. Entire zone
3. Total

The region south of the Stanovoy Range is characterized by increased seismic activity. A perceptible earthquake with M=5.4 was felt here on 2 November 1973 in the Tukuringra Range region. The macroseismic information gathered in investigating the region of the earthquake by V. V. Nikolayev and R. M. Semenov, associates of the Institute of the Earth's Crust of the Siberian Department of the USSR Academy of Sciences is presented in Table 2.

The possible intensity of the shock at the epicenter was 7-8 points. After the jolt over 10 aftershocks with $K \geqslant 9$ were recorded. Weak repeated jolts were not registered in view of the distance of the seismological stations from the epicenter. The relation of this earthquake and its aftershocks to the Tukuringra deep fault with a latitudinal strike is obvious. In 1972 a jolt with M=5.6 was also registered in this region.

A high level of seismicity is noticeably singled out in the region of the Cherskiy Range system in the northeast of the territory. The southeast end of the Cherskiy Range at its transition to the Northern Okhotsk region is particularly active. A concentration of epicenters of repeated jolts is observed here in the areas of the strong earthquakes of 1970-1972. There is no doubt as to their gravitation toward the zones of influence of the major tectonic faults--the Nerskiy and Khenikinskiy [3].

Individual earthquakes were recorded in the northwest region. Their origin was probably related to the movements along one of the central faults of the Cherskiy-Darpir ranges. In 1973 the coordinates of 91 jolts could be determined in the region of the Cherskiy Range system.

Table 3 shows the distribution of the earthquakes in this entire region with respect to energy.

The region of the Dzhugdzhur Range and coastal region of the Sea of Okhotsk is quite seismic. There the basic mass of earthquakes is localized along the northern coast of the Sea of Okhotsk from the Koni Peninsula to Taygonos Peninsula. The relation between the area of concentrated epicenters near the city of Magadan and the Chelomdzha-Yamskiy fault is bein traced once more.

The Verkhoyanskiy Range was more active than in 1968-1972. One of the reasons for the "activity" in the northern section (lower reaches of the Yany River) is probably the opening of the seismological station at the settlement of Batagay. As a result, it became possible to find the coordinates of the epicenters of individual earthquakes with K $\geqslant$ 9-10 from the cross bearings of the stations at Tiksi, Batagay, Ust'-Nera, Khandyga and Yakutsk. The epicenters of this section form a line that approximately coincides with the path of the submeridional Omoloyskiy fault.

The material presented attests to the need to develop seismic observations in the north of Yakutiya and the northeast of Magadanskaya Oblast, which will make it possible to obtain more complete information in the future on the seismicity of these regions.

Catalog of Earthquakes in Yakutiya and the Northeast With K $\geqslant$ 8 in 1973.

№ п/п	Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	Класс точности	*K*	№ района
			φ^0N	λ^0E				
1	2	3	4	5	6	7	8	9

Key:

1. Number, in order
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ °N
5. Coordinates of epicenter: λ °E
6. Focal depth, in km
7. Accuracy class
8. K
9. Number of region

January

	2	10 42 36	69,0	132,6		A	9	8
	3	22 12 51	63,9	145,0		A	8	10
		22 47 53	57,5	121,4		A	9	1
		23 01 06	59,3	142,2		A	10	6

1	2	3	4	5	6	7	8	9
	5	13 12 36	56,2	123,7		A	8	2
		16 02 06,2	56,50	121,26		а	8	1
		19 26 50	61,8	150,8		A	10	6
	6	17 46 35	54,2	124,6		A	8	4
	9	02 11 22	53,7	125,8		A	9	4
		05 48 05	63,6	147,5		A	8	10
	10	16 01 51	61,9	140,3		A	8	6
	12	05 18 37	64,4	146,1		A	8	10
	15	21 05 29,6	56,48	121,20		а	8	1
	17	18 03 15	62,2	139,0		A	9	7
	18	11 53 07	54,4	126,5		A	8	4
	20	01 37 26	63,6	147,5		A	8	10
	23	10 33 54	65,5	136,6		A	8	9
		12 47 26	61,7	140,4		A	8	6
	26	09 59 47	55,9	130,4		A	9	2
	27	07 08 49	61,1	136,6		A	8	7
		15 33 11	61,7	140,3		A	8	6
		19 54 33	61,7	140,0		A	9	6
	28	02 33 56	63,4	147,6		A	9	10
		06 23 52	62,4	143,9		Б	9	9
		16 47 21	56,0	130,2		A	9	2
		23 58 30	65,7	137,6		A	8	9
	29	09 04 08	57,7	126,5		A	9	3
	30	12 07 38	64,1	145,7		A	8	10
1		22 53 23	56,6	128,9		A	11	3
	31	18 17 37,8	56,54	121,14		б	9	1
				February				
	1	18 40 20,4	56,25	123,56		б	8	2
	2	11 10 42	60,8	147,4		A	8	6
	3	05 26 58	62,7	149,4		A	8	10
	4	01 49 08	63,6	147,3		A	8	10
		09 08 31	64,3	145,8		A	8	10
	6	17 31 13,8	57,62	121,07		б	8	1
	7	11 48 54,9	57,62	121,07		б	8	1
	8	08 54 00	55,8	127,6		A	8	2
	12	14 39 12	67,7	131,8		A	9	8
	15	18 23 42	61,0	151,7		A	8	6
		23 53 47	64,2	145,8		A	9	10
	16	09 54 48	64,2	146,0		A	9	10
		19 46 46	61,0	151,8		A	8	6
	17	09 47 52	59,9	152,9		A	8	6
	18	03 53 50	62,6	146,0		A	8	10
	20	14 39 56	64,0	146,4		A	10	10
	22	05 44 16	54,1	123,9		A	10	4
		21 01 37	54,3	122,6		A	9	4
	23	05 05 08	61,5	147,7		A	9	6
		06 32 24	56,9	127,7		A	8	2
	25	16 32 53,3	56,61	121,16		б	9	1
		17 29 25	58,0	128,1		A	8	3
	28	08 55 36	63,4	155,3		A	8	10

1	2	3	4	5	6	7	8	9
March								
	1	14 30 03	56,2	128,5		А	10	2
		22 23 02	59,8	152,7		А	9	6
	2	10 40 52	64,1	146,0		А	8	10
	5	06 08 26	61,6	140,7		А	10	6
	7	09 25 05	63,5	146,3		А	8	10
		10 12 19,5	56,41	121,24	22	б	8	1
		13 45 52	63,2	146,4		А	8	10
		22 33 55	53,9	125,2		А	8	4
	8	10 32 49	60,3	153,4		А	9	6
		13 49 54	60,0	152,7		А	8	6
		20 02 12	63,5	146,5		А	8	10
		21 56 54	72,2	134,7		Б	9	8
	9	03 17 41	57,7	133,5		А	8	5
		07 35 13	62,9	148,1		А	8	10
		20 30 41	64,2	145,7		А	8	10
		23 15 12	72,8	136,9		А	10	8
	10	05 42 52	61,3	147,4		А	8	6
		11 52 50	57,3	122,4		А	8	2
	19	02 54 28	64,5	152,4		А	8	10
	21	10 14 58	60,0	152,9		А	10	6
	22	20 51 19	56,2	135,8		А	9	5
	23	02 50 50	54,2	123,2		А	8	4
		15 33 12,9	56,82	121,81	17	а	8	1
	24	09 11 14	60,8	150,0		А	8	6
	26	05 02 13,3	56,57	121,11	13	а	8	1
	29	16 01 10	64,1	145,6		А	8	10
	31	07 40 31	64,1	145,9		А	8	10
		08 22 42	62,0	147,0		А	8	6
April								
	1	04 29 39	63,6	147,4		Б	8	10
	2	01 21 47	60,4	152,0		А	9	6
		10 59 10	64,3	145,9		А	8	10
		22 12 00	57,0	126,0		А	8	2
	3	04 03 40	62,8	148,4		А	8	10
		05 06 34	61,3	143,1		А	10	6
	5	09 08 14	57,5	127,4		А	8	3
		16 11 31	66,1	136,2		А	9	9
	6	17 03 29	63,6	154,4		А	8	10
	7	23 46 22	60,2	149,4		А	8	6
	8	01 47 02	63,6	146,9		А	8	10
		03 16 43	63,4	146,8		А	8	10
		07 29 02	61,8	147,1		А	9	10
	9	12 48 57	60,2	155,5		А	8	6
		15 45 18	62,6	149,2		А	8	10
		16 36 47	65,0	148,8		А	9	10
	10	15 24 51	64,4	146,2		А	8	10
	13	06 17 40	61,8	149,4		А	8	6
		08 43 12	63,5	149,4		А	8	10
		10 27 17	54,3	123,9		А	8	4
		10 36 34	62,0	147,0		А	9	10
	14	01 00 45	62,8	152,8		А	8	10
		20 57 01	56,6	121,2		А	9	1
		21 42 10	54,4	125,8		А	9	4
	15	20 38 29,6	56,56	121,04		б	8	1

1	2	3	4	5	6	7	8	9
	19	05 20 46	63,5	147,1		А	8	10
		08 32 37	61,4	148,0		А	8	6
		11 33 33	56,6	125,9		А	8	2
	22	00 38 20	56,9	123,7		А	9	2
		10 06 38	54,6	123,0		А	9	4
	24	01 57 20	60,3	153,0		А	9	6
		21 40 27	66,0	140,3		А	8	10
	25	11 41 56	57,1	122,1		А	8	2
	29	03 18 07	56,2	131,2		А	8	2
		06 18 51	54,6	124,7		А	10	4
		15 49 29	54,6	122,8		А	8	4
		20 01 58	58,6	133,0		А	8	5
	30	08 13 20	61,9	143,7		А	8	9
		17 49 59,4	56,70	123,49		б	8	2
		20 23 44	62,3	156,0		А	8	6
				May				
	1	16 44 55	62,1	146,6		А	9	10
	4	12 29 35	54,2	127,3		А	8	4
		20 13 33,9	56,61	121,19		б	8	1
		21 52 32	53,9	125,0		А	8	4
	6	01 07 02	54,2	126,7		А	8	4
	7	18 56 29	57,4	127,1		А	8	3
	10	19 32 19,3	56,81	121,00		б	9	1
	11	21 27 55	61,7	145,7		А	9	6
	12	05 26 28	63,4	146,6		А	8	10
	14	17 04 54,5	57,43	122,75		б	8	2
	15	14 06 01,7	56,50	121,10		б	8	1
		14 48 06,2	56,50	121,00		б	9	1
		19 44 34	64,4	146,2		А	9	10
2	18	03 37 53	63,4	145,6		А	11	10
	19	02 24 26	59,9	152,7		А	10	6
		05 58 47	59,9	152,8		А	8	6
	20	08 53 52	61,8	145,8		А	9	6
		21 50 09	60,0	152,9		А	8	6
	21	03 25 41,2	56,52	121,07		б	9	1
	22	11 12 43,9	56,57	121,08		б	8	1
	24	05 26 24	63,6	147,4		А	8	10
	25	20 04 34,7	56,76	122,66		б	8	2
	26	09 41 43	64,5	139,5		А	8	9
		21 55 09	61,6	153,8		А	8	6
	27	05 49 11	62,0	161,5		А	10	6
	31	10 00 00	54,3	123,9		А	8	4
				June				
	3	03 54 36	64,1	145,7		А	8	10
		05 28 55	63,9	149,0		А	8	10
		06 37 09	57,9	130,4		А	8	3
	4	13 47 08,9	56,25	123,77	13	б	8	2
		17 37 41	71,3	133,4		Б	9	8
		19 10 45	61,1	136,7		А	9	7
	6	17 33 11	64,2	146,0		А	8	10
	8	02 47 28	54,3	123,2		А	8	4
3		11 43 51	64,0	146,3		А	12	10
		17 03 32	60,0	153,0		А	8	6
		21 37 56	61,8	158,2		Б	9	6

1	2	3	4	5	6	7	8	9
		22 35 57	62,4	158,7		Б	9	6
	9	04 59 52	62,1	144,8		А	9	6
		06 45 08	63,1	144,9		А	8	10
	14	00 04 31	61,0	145,5		А	8	6
		09 21 38	61,8	143,6		А	8	6
4	15	20 10 18	62,0	147,3		А	11	10
	16	02 12 14	59,8	153,0		А	10	6
		02 18 32	61,9	147,4		А	9	10
		19 36 05,9	56,89	122,87		б	8	2
	17	02 39 08	63,3	146,9		А	9	10
		14 59 52	56,9	131,3		А	9	3
		15 56 45	64,2	145,8		А	8	10
5	18	13 59 47,7	56,52	121,09	19	б	11	1
		15 02 26,7	56,54	121,03		б	8	1
	21	02 49 54	63,4	146,6		А	8	10
		04 14 20	61,7	146,8		А	8	10
		10 40 19,5	56,86	122,05		б	8	2
	24	00 25 53,4	56,61	121,00	17	б	8	1
		00 26 15,9	56,60	120,98	9	б	8	1
		06 59 11	67,0	139,3		А	9	10
	26	12 52 17	57,2	127,8		А	8	3
		14 35 30,4	56,63	124,33	12	б	8	2
	28	10 02 02,0	56,56	121,00		б	8	1
		15 31 24	55,6	132,7		А	9	2
				July				
	1	01 48 27	63,1	146,2		А	8	10
	2	06 16 18	64,1	145,1		А	9	10
	5	04 54 09	54,8	124,3		А	8	4
	5	14 56 14	62,3	140,9		А	8	8
		15 40 25,2	56,56	121,19		б	8	1
	6	08 53 35	57,3	120,3		А	8	1
	7	13 22 21,0	56,55	121,02		а	8	1
	8	00 29 20,2	56,61	121,09		б	8	1
	14	02 08 48	63,2	146,8		А	9	10
	15	13 41 23	67,8	111,9		А	8	10
		14 27 15	67,8	138,8		А	8	10
		16 54 12	61,9	147,2		А	8	10
	18	07 54 04	62,0	147,2		А	8	10
	19	02 58 32	63,9	148,1		А	8	10
		15 56 24	60,0	153,0		А	9	6
		15 58 25	60,0	152,9		А	8	6
	20	16 24 21,7	56,50	122,96		б	9	2
		20 44 06,2	56,25	124,55	15	а	9	2
		21 05 35,8	56,25	124,54	19	а	8	2
	21	06 58 12,4	56,29	124,56	16	а	8	2
	22	07 25 11,9	56,54	121,00	16	б	9	1
		18 24 19	53,7	125,4		А	8	4
	23	13 08 05	55,6	132,5		А	9	2
		17 27 18,0	57,98	124,44		б	8	3
	24	21 47 47	62,2	156,5		А	10	6
	25	07 01 45,8	56,81	126,78		б	9	2
		18 14 13,0	56,21	123,68		а	8	2
	26	14 10 22	61,9	147,2		А	8	10
	27	15 09 22	60,1	153,4		А	10	6

1	2	3	4	5	6	7	8	9
	29	09 32 32	64,1	146,5		А	9	10
	30	13 37 47	56,3	129,4		А	9	2
	31	15 58 49	54,7	124,9		А	8	4
				August				
6	1	00 45 39	59,2	141,4		А	11	6
		16 27 39,0	56,70	124,08	15	а	8	2
	2	02 44 49,7	56,26	123,67	23	б	8	2
	6	16 49 55	63,2	145,4		А	8	10
	9	09 21 16,6	56,23	123,69	8	б	8	2
	10	12 48 43	60,1	153,4		А	9	6
		18 23 43,3	56,70	121,13	21	а	8	1
	12	00 58 49	63,4	146,8		А	8	10
		16 57 06	61,9	147,0		А	8	10
7	13	06 50 24	62,7	145,8		А	11	10
	16	04 23 48,8	57,59	120,60		б	8	1
	17	00 23 13,4	54,75	124,12		б	8	4
	18	05 04 55	63,5	147,2		А	9	10
		10 07 24,4	56,25	123,61	18	а	8	2
		12 45 45,5	57,02	120,13		б	8	1
	20	11 22 59	57,6	124,0		А	8	2
8		21 03 47	61,1	148,3		А	11	6
	21	01 26 56	67,1	139,5		А	10	10
	22	17 42 37,5	55,61	122,71		а	8	4
	24	12 41 48,9	57,50	120,52		б	8	1
		22 37 24	72,0	127,3		Б	9	8
	25	19 05 45	57,0	125,8		А	9	2
	27	15 35 41,4	56,24	123,74		б	8	2
	28	11 58 40	62,4	149,6		А	8	10
		12 43 34	69,8	132,3		Б	9	8
	29	05 22 35	61,6	152,5		А	8	6
				September				
	2	22 44 01	56,8	129,2		А	10	3
	3	16 16 45	61,6	148,0		А	8	10
	4	11 24 10	55,4	125,2		А	8	4
		12 15 09	54,9	123,2		А	9	4
	5	12 25 48,4	56,40	124,75		а	8	2
	7	01 50 35,4	56,24	123,57		б	8	2
		10 47 20,6	56,23	123,54		б	8	2
	8	02 44 56	63,2	146,6		А	8	10
	9	01 42 14,5	56,50	120,98		б	8	1
	12	00 36 47	62,4	143,7		А	9	9
	13	12 25 55	56,9	122,5		А	9	2
	14	11 00 44,3	56,61	121,00		б	8	1
9	15	07 15 06	63,3	154,5		А	11	6
	16	17 54 54	61,5	140,6		Б	9	6
		23 19 44	67,1	143,6		Б	8	10
	19	01 49 46	63,4	154,6		А	9	10
		03 44 19,8	56,34	122,80		б	9	2
		11 09 16	62,4	155,1		А	8	6
	23	04 44 30	57,9	127,2		А	8	3
		04 51 19	57,1	122,1		А	8	2
	25	00 35 35,3	56,54	121,12	13	а	8	1
	27	12 48 16	58,0	126,7		А	8	3
	29	04 04 58	63,5	147,3		А	9	10

1	2	3	4	5	6	7	8	9
				October				
	2	07 51 25,7	56,55	121,16	18	б	9	1
	6	14 59 20	57,0	128,0		A	9	2
	12	03 08 42	61,5	143,0		A	10	6
		07 38 28,0	56,60	120,85		б	8	1
	16	03 07 59	58,6	148,7		A	9	6
	19	05 28 24	57,2	127,6		A	8	2
	22	05 12 55	57,6	121,1		A	10	1
	23	17 16 22,5	56,56	120,97		б	8	1
		22 29 21,2	56,54	120,94		б	8	1
	26	11 26 56,4	56,20	123,57		б	10	2
		11 30 01,2	56,22	123,61		б	10	2
		12 05 18	56,2	123,5		A	8	2
	28	17 45 53	64,2	146,0		A	10	10
	29	00 15 05	73,2	143,2		Б	10	8
		10 53 55	57,2	132,8		A	9	5
				November				
	1	14 54 37	56,6	124,3		A	8	2
	2	02 49 34	59,8	153,2		A	10	6
10		07 31 34	54,0	125,6	30	A	14 (M = 5,4)	4
		08 17 01	53,1	127,9		A	9	4
		12 14 48	54,3	125,8		A	10	4
		16 03 15	54,2	125,7		A	8	4
		16 59 10	54,3	125,6		A	8	4
	3	05 16 16	63,9	148,0		A	8	10
		09 17 18	54,1	127,5		A	8	4
	4	10 27 14	54,2	125,8		A	8	4
	5	06 28 28	54,2	125,6		A	8	4
	8	01 33 13	57,7	127,0		A	8	3
	9	10 45 04	54,2	127,2		A	8	4
	13	02 13 43	66,7	139,6		A	10	10
		05 46 17	56,6	122,8		A	8	2
		15 34 32	57,3	125,3		A	8	2
	14	17 12 41	62,3	143,6		A	10	10
	15	11 11 16	54,1	126,0		A	10	4
	16	16 40 04	57,6	127,9		A	9	3
	18	08 17 41	64,1	146,0		Б	9	10
	19	15 26 32	56,6	123,1		A	8	2
	21	05 33 54	57,7	127,9		A	8	3
	24	23 51 10	70,2	133,4		A	10	8
	25	05 58 51	63,1	146,4		A	9	10
		12 46 27	70,4	133,5		A	9	8
	26	10 33 44	70,4	133,5		A	9	8
	28	09 25 14	63,6	146,7		A	8	10
		13 23 46	55,4	123,2		A	8	4
11	29	00 03 19	56,1	123,7		A	11 (M = 4,0)	2
		12 48 53,7	56,67	121,00		б	8	1

1	2	3	4	5	6	7	8	9
				December				
	1	17 36 52	66,2	130,9		A	9	8
	2	08 25 28	71,6	129,7		A	9	8
		13 10 40	57,0	126,9		A	8	2
	4	17 04 12,6	57,38	120,83		6	10	1
	5	08 59 52	56,1	123,6		A	8	2
		10 22 30	56,3	123,6		A	8	2
	6	06 31 13	56,3	123,5		A	8	2
	9	20 02 08	62,0	147,8		A	9	10
	11	00 28 23	55,6	130,5		A	8	2
		08 31 00	57,2	126,6		A	8	2
	12	07 29 34	56,9	127,3		A	8	2
		14 35 34	66,2	131,9		A	8	8
		21 51 12	56,2	123,6		A	8	2
	14	18 17 11	55,0	125,0		A	8	4
	15	05 05 47	62,0	147,5		A	8	10
	16	04 55 31	61,9	147,4		A	10	10
	17	13 47 56	61,9	147,6		A	8	10
		18 03 14	54,3	125,7		A	8	4
	19	12 48 04,6	56,57	121,27		6	8	1
	20	00 31 42	70,3	133,0		A	9	8
	22	04 41 46	62,6	153,7		A	9	6
	25	21 04 29	65,9	147,7		A	8	10
	27	03 21 41	63,3	146,5		A	8	10
	28	05 10 52	60,0	152,2		A	8	6
	29	00 10 35	57,2	123,4		A	9	2
		02 46 46	56,2	123,8		A	8	2
	30	03 47 25	59,6	151,3		A	8	6
		15 05 26	56,5	121,0		A	8	1

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EARTHQUAKES IN KAMCHATKA AND THE KOMANDORSKY ISLANDS

S. A. Fedotov, I. G. Simbireva, V. D. Feofilaktov

In 1973 detailed seismological observations were continued in Kamchatka and the Komandorsky Islands.

The Kamchatka network of seismological stations and ensuring the operation of the equipment was under the direction of the Laboratory of Seismometry of the Institute of Volcanology of the Far East Scientific Center of the USSR Academy of Sciences, headed by V. D. Feofilaktov. The earthquakes in 1973 were processed by a laboratory group including: T. S. Lepska (responsible), I. P. Grigor'yeva, Z. A. Borisova, Zh. A. Yerokhina, L. I. Pribylova and Ye. V. Popkova. The editing of the catalog and preparation of the material under review for press was performed in the seismology laboratory (head of the laboratory I. G. Simbireva). The general direction of the seismic observations in Kamchatka was carried out by S. A. Fedotov.

In 1973 the network of seismological stations was expanded as compared with 1972 by opening two new temporary stations at the settlement of Ossora and on Mednyy Island. The first was equipped with a three-component instrument unit with standard frequency responses for the Kamchatka network of stations and the second--with a single Z-component VEGIK instrument unit, less sensitive, with standard characteristics.

Processing the information and determining the standard characteristics of the seismicity remained the same in 1973 as in preceding years.

The energy class of the earthquakes was determined from the maximum phases of the body S-waves according to the travel-time curve of S. A. Fedotov [1].

The results of processing earthquakes with the 10th energy class ($K_{S_{1,2}}^{\phi 68} \geqslant 10$) are assembled in the catalog. Introduced into the catalog are the classes of accuracy of determining the epicenters and depths of the focal points, distinguished from the generally accepted ones in the Atlas of Earthquakes in the USSR and corresponding to the following values: a--± 5 km, b--± 10 km, N--± 16-25 km, s--$>$ 25 km. The seismicity is illustrated by maps of the epicenters of the earthquakes with the 8th energy class (figs. 1, 2, see inset), by the map of the activity (Fig. 3) and by the vertical section transverse to the volcanic arch (Fig. 4).

In 1973, on the territory of the Kamchatka survey ground, 1,838 earthquakes were recorded and processed, distributed by energy as follows:

$K_{S_{1,2}}^{\Phi 68}$	8	9	10	11	12	13	14	15	16
Number of earthquakes	621	683	366	111	31	18	5	2	1

In 1973 the seismicity in Kamchatka and the Komandorsky Islands was higher in some regions of Kamchatka than in 1972, but on the average did not differ from the seismicity level during the period of detailed seismological observations in 1961-1972.

The region east of the Paramushir and Shumshu islands was the most active. Beginning in 1970 the seismic activity of this region slowly rose, and in 1973 a series of strong earthquakes occurred here, which caused a sharp growth in the activity, the maximum value of which reached A_{10} = 12 (in 1972 A_{10} = 3.8).

The strongest was the earthquake on 28 February, with $K_{S_{1,2}}^{\Phi 68}$= 15.5, M=7.5, after which a series of aftershocks followed throughout the year (see separate article in this collection).

The growth of the seismic activity was also observed in the regions of the Kronotskiy Peninsula and Kronotskiy Bay, where the activity almost tripled as compared with 1972. The isolines A_{10}=3.0 stretched from the Kronotskiy Peninsula to the southern part of Kronotskiy Bay and outline an area of 200 X 40 kilometers. Two earthquakes occurred alongside Kronotskiy Peninsula and Kronotskiy Bay: on 4 March with $K_{S_{1,2}}^{\Phi 68}$ = 13.4, M=6.2, and on 27 November, with $K_{S_{1,2}}^{\Phi 68}$ =13.9, M=5.6, with a series of aftershocks following them.

In the region of the Kamchatka Peninsula and in Kamchatka Bay the number of earthquakes was considerably reduced. After the earthquake on 15 December 1971, along the Ust'-Kamchatsk Peninsula (M=7.7) and the subsequent series of aftershocks, the level of activity in this region dropped from A_{10}=14.7 in 1971, A_{10}=5.4 in 1972 to $A_{10} \sim 1$ in 1973.

In the Komandorsky Islands and on the territory of Kamchatka Peninsula itself, the seismic activity, just as in 1972, was low.

In the regions of the Shipunskiy Cape and Avachinskiy Bay, the seismic activity was unchanged as compared with 1972. Only in the eastern part of Avanchinskiy Bay did the lines of seismic activity shift toward the Kuril-Kamchatka basin.

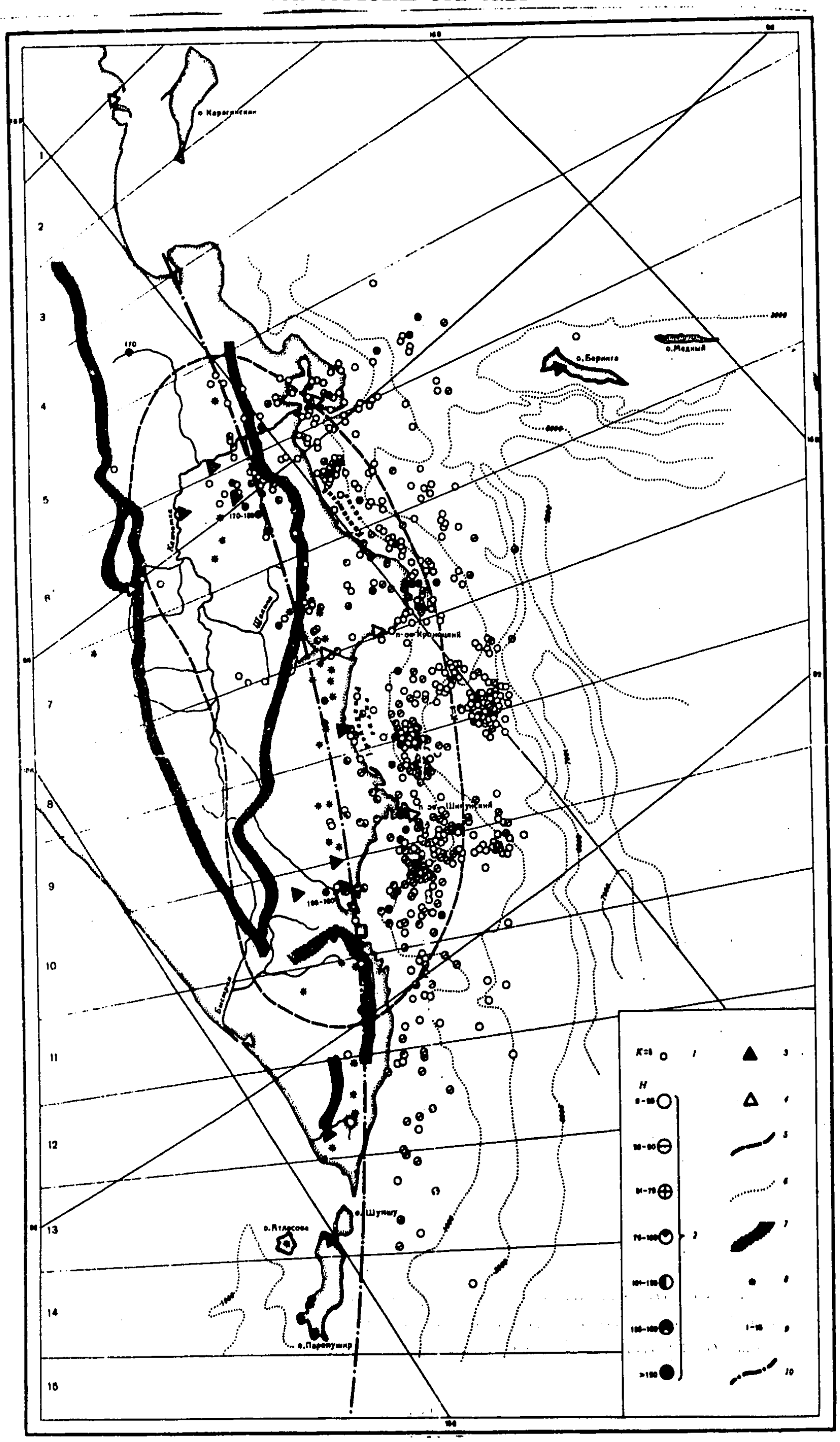

Figure 2. Map of Epicenters of Earthquakes in Kamchatka and the Komandorsky Islands With K=8
[Key ou Following Page]

Key to Figure 2.

1--energy of earthquakes; 2--depth of focus, in km; 3--permanent seismological stations; 4--temporary stations; 5--boundaries of area of certain recording of earthquakes; 6--depth contours; 7--principal mountain ranges of Kamchatka; 8--volcanoes; 9--sectors of volcanic arc; 10--axis of volcanic arc

Therefore, in 1973 an increase in seismic activity was observed in the south of Kamchatka, Kronotskiy Bay and Peninsula, and a reduction in the activity in Kamchatka Bay and on the peninsula. Earthquakes occurred mainly at depths of up to 50 kilometers. No strong earthquakes occurred at great depths.

Macroseismic Data

The strongest earthquake on the territory of Kamchatka with respect to the macroseismic effect in 1973 was the one on 28 February at 06:37. It caused a shock with an intensity of 6 points in the southern regions of Kamchatka and was felt even in the north of the peninsula: in the settlement of Krutoberegovo with an intensity of 4 points and in the settlement of Nikol'skoye, on Bering Island, with an intensity of 2-3 points. A separate article is devoted to this earthquake in this collection.

Of the other perceptible earthquakes, the strongest (5-6 points) were the earthquake on 11 June at 08:43, which caused a 5-point tremor in the settlement of Kronoki, and the earthquake on 26 October at 03:23, which was felt with an intensity of 5-6 points in the settlement of Krutoberegovo. According to the report of I. A. Bogatov, head of the seismological station, the latter earthquake was noticed by persons who were not moving around, on the first floor of a building. Both long- and short-period vibrations were felt. Floors and ceilings creaked, dishes rattled, hanging objects started to swing, and water in open vessels vibrated. Cracks appeared in brick ovens. The jolts were noticed by a person who was not moving around. Some of those questioned felt dizzy and slightly nauseated. The earthquake lasted about 90 seconds.

In addition to the earthquakes on the territory of Kamchatka given in the catalog, a series of perceptible earthquakes of a particularly local nature was recorded, which were felt and one location and were recorded by only one seismological station. The instrument data on these earthquakes is insufficient to determine the coordinates of the focus. A list of the earthquakes is given below.

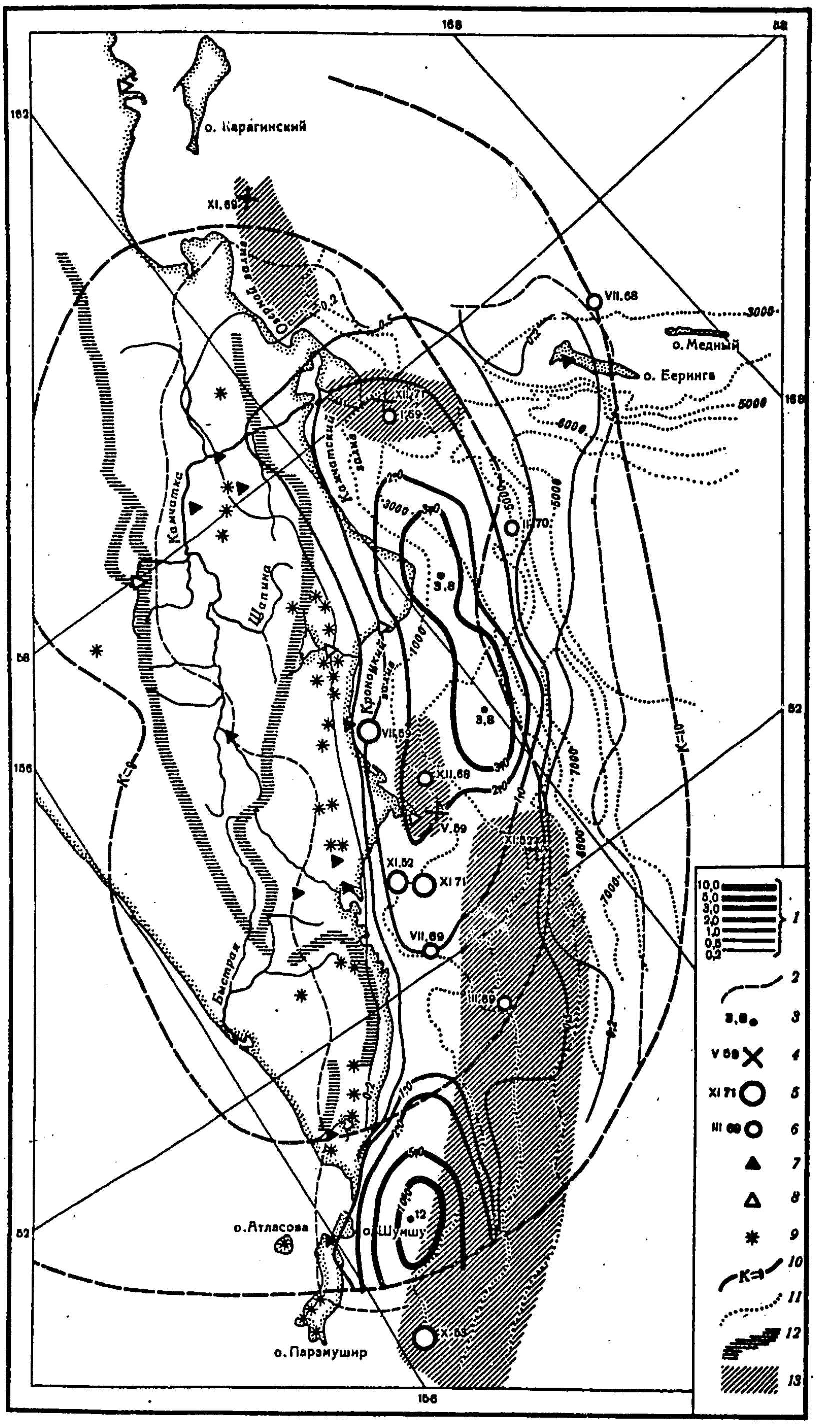

Figure 3. Map of Seismic Activity in Kamchatka and the Kmandorskiy Islands
[Key on Following Page]

Key to Fig. 3:

Isolines of seismic activity in units A_{10}: 1--certain, 2--uncertain; 3--maximums of seismic activity in units A_{10}; epicenters of strong earthquakes in 1952-1972 of energy classes: 4--K=17; 5--K=16; 6--K=15; 7--permanently operating seismological stations; 8--temporary stations; 9--volcanoes; 10--outlines of positive registration of earthquakes; 11--depth contours; 12--principle mountain ranges of Kamchatka; 13--areas of focal points of strongest earthquakes: November 1952, May 1959, November 1969, December 1971.

13 January, 22:05, settlement of Tymlat (5-6 points). doors opened, and window frames were bent and ovens were partially destroyed. The population was frightened (report of A. V. Tatarinov, head of the seismological station). Settlement of Ossora (4 points). A rumble was heard, hanging objects and light furniture swayed, and glasses and dishes rattled (report of A. V. Tatarinov).

20 January, 13:50, settlement of Ossora (3-4 points). The earthquake was accompanied by a rumble. Lamps swayed and radio equipment oscillated (support 1.8 meters high). At the settlement of Tymlat people were awakened and dishes rattled (3-4 points) (report of A. V. Tatarinov).

24 June, 02:45, settlement of Pauzhetka--3-4 points.

2 August, 06;45, city of Petropavlovsk-Kamchatskiy--2-3 points.

3 August, 17:32, settlement of Kronoki (3 points). According to the report of workers at the seismological station at the settlement of Pauzhetka, a cluster of earthquakes with S-P 1-2 seconds was felt: 22 August, 03:20, 2-3 points: 22 August, 03:21, 2-3 points; 10 September, 21:34, 3 points: 12 September, 12:00, 3 points; 13 September, 01:34, 2-3 points; 17 December, 02:43, 2-3 points; 17 December, 07:59, 3-4 points; 17 December, 07:59, 3-4 points; 17 December, 14:32, 3-4 points.

29 December, 05:37, Mednyy Island, settlement of Preobrazhenskoye (3-4 points). Floors creaked, dishes rattled and lamps swayed.

30 December, 05:52, city of Petropavlovsk-Kamchatskiy (about 2 points). The earthquake was felt on the fourth floor of a large-block building (report of Z. A. Borisova, associate of the Institute of Volcanology).

The coordinates of the earthquake were determined as approximately: $\varphi = 53.03°N$, $\lambda = 158.60°E$, $H = 0$, $\Delta = 30$ km, $K_{S_{1,2}}^{\Phi 68} = 8$.

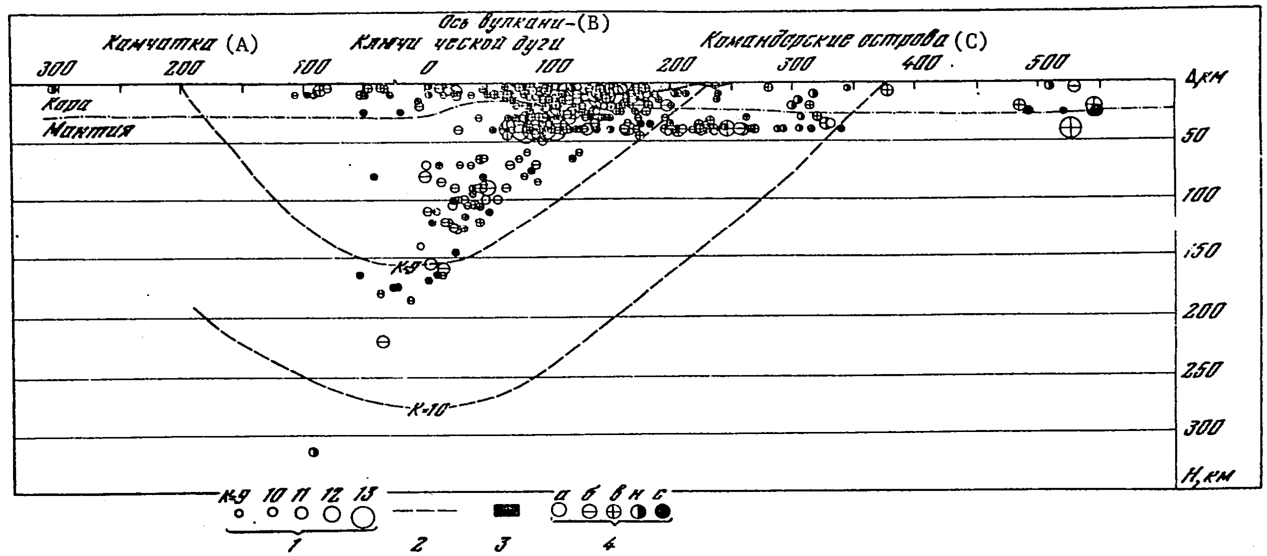

Figure 4. Projection of Hypocenters of Earthquakes in Vertical Section Transverse to the Strike at Kamchatka (sectors 4-8).

1--energy of earthquakes; 2--boundaries of areas of certain registration of earthquakes; 3--water; 4--class of accuracy of determining depth of focus of earthquake; A--Kamchatka; B--axis of volcanic arch; C--Komandorsky Islands

Catalog of Earthquakes in Kamchatka and the Komandorsky Islands in 1973

№ п/п (K > 11,5)	Число	Момент возникновения, час, мин, сек	Координаты эпицентра φ°N	λ°E	Глубина очага, км	Класс точности	K	M	№ района	Макросейсмические данные
1	2	3	4	5	6	7	8	9	10	11

Key:

1. Number, in order (K 11.5)
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ °N
5. Coordinates of epicenter: λ °E
6. Focal depth, in km
7. Accuracy class
8. K
9. M
10. Number of region
11. Macroseismic data

January

1	2	3	4	5	6	7	8	9	10	11
	1	08 17 39,0	55,51	166,37	30–40	аа	9,6		20а	
		13 30 50,5	55,87	163,50	10–20	ав	9,6		5-6	
		16 21 43,5	54,30	161,49	20	аа	9,6		8	
	3	06 17 16,5	50,57	157.15	10–40	сн	10,5		13	
	4	13 35 53,2	50,43	156.90	0	ан	9.7		13	
1	6	15 05 38,8	49.09	158.18	0	вв	11.7	4,7	22г	
	8	23 17 26.5	50,70	158.25	0	вв	10.9		12	
	9	08 58 40,0	53.15	152.40	450	сс	10,7	3.6		
	11	02 57 53,0	56.01	164.09	10-20	бв	10.6	4,3	20а	
	12	22 10 52,5	53,58	160,73	30–40	аб	9.9		9	
	18	14 27 26,0	53,28	161,66	10–20	бв	9.8		9	
	19	04 20 00,5	55,74	161.25	100–110	бб	10.2		6	
	20	15 47 20,5	53,87	160.29	100	аб	9,7		8	Кроноки. 2 балла
	21	14 21 43,1	55,70	160.21	0	ав	9,5		17б	
		18 10 06,5	51,32	159,10	0	аб	9.6		11	
		23 37 03,4	55,70	160,21	0	ав	9,6		17б	
	24	09 45 05.0	55,51	162.58	10	аб	10,2		6	
2	25	18 32 29,5	54.50	161.68	40	аб	13.0	5.0	7	Петропавловск-Камчатский. 3 балла: Семлячик. 4 балла
	26	07 16 54,2	50,75	157,69	20–30	бв	10,0		13	
3	27	04 04 37,6	50,02	156,85	10–40	нн	12,2	5,2	14	Паужетка, 3 балла
		21 12 54,0	54,17	162,41	10	аб	9,6		8	
	29	16 48 41,0	50,22	159,80	30	ав	9,6		22б	
4	30	04 00 50,5	54,99	162,29	10–20	аб	11,6		7	

February

1	2	3	4	5	6	7	8	9	10	11
	1	02 38 16,5	53,41	160,35	30–40	аб	10,1		9	
	3	01 55 11,5	54,15	162,50	10–20	бв	9,5		8	
	4	01 16 10,5	50,90	157,75	10–20	ав	10,6		12	
	5	03 20 40,6	55,48	161,47	120	аб	9,9		6	
	6	00 23 42,8	56,10	162,75	5–10	ав	9,6		5	

1	2	3	4	5	6	7	8	9	10	11
	7	15 35 47,8	56,26	161,46	80–90	аб	10,3		5	
		18 51 28,3	53,86	159,90	100–110	бб	9,5		9	
		19 29 54,5	54,52	162,30	40	аб	10,5		7	
5	8	02 35 02,5	49,65	156,85	0–50	нв	12,3		14	
		06 50 24,5	55,04	162,30	20	ав	9,5		7	
		12 01 19,5	55,68	163,89	10	ав	10,9	4,1	20б	
6	10	16 55 34,0	49,80	156,27	0–50	сс	13,5	5,5	14	
	13	07 10 48,3	55,77	162,34	20–30	аб	9,5		6	
	14	06 45 57,0	51,35	156,83	220	вб	10,9		12	
7	15	07 28 41,4	55,98	163,50	10	аб	11,8		5	Крутобереговo, 4–5 баллов
		17 37 23,7	52,45	159,30	20	аа	9,5		10	
		23 52 54,5	55,03	163,15	40	ав	9,6		6	
	18	12 27 42,8	55,75	161,15	160	аб	10,5		6	
	20	09 30 42,8	52,78	159,58	40	ав	9,7		10	
	21	22 32 29,0	56,52	161,29	20	аб	9,5		5	
	23	02 18 35,0	55,54	163,55	40	бв	10,0		6	
	24	06 39 12,0	54,81	164,20	30–40	аб	9,8		20б	
	25	02 21 52,0	50,17	157,05	10–40	вв	9,9		13	
		03 58 56,0	54,94	165,73	10	ан	9,8		20б	
	26	02 57 59,0	56,10	163,22	20	аб	11,2		5	Крутобереговo, 4 балла
8		08 16 55,5	49,26	156,22	0–50	сс	11,7		14	
		17 07 49,4	50,43	157,05	10–20	бн	9,6		13	
		18 00 11,2	50,75	160,42	40	аб	10,2		22б	
	27	04 58 05,4	53,63	167,98	10	аб	9,9		20в	
9	28	06 37 54	50,4	156,7	70	нн	15,5	7,5	13	See separate article
		06 43	50,20	157,20	0–40	сс	11,0		13	
		06 46 59,0	50,42	156,83	10–40	вн	10,9		13	
10		06 49 30,0	50,43	157,85	10–40	бн	12,3	4,9	13	
11		06 51	50,20	157,30	0–40	сс	13,4	5,3	13	
12		06 56	50,20	157,30	0–40	сс	13,0	5,5	13	
		06 58	50,20	157,30	0–40	сс	11,4		13	
		08 05 48,5	50,18	157,25	0–40	нн	10,3		13	
13		08 07 42,5	50,30	157,80	40	ав	11,7		13	
14		08 14 24,0	50,55	157,65	40	аб	11,7		13	
		08 23 22,5	50,20	157,10	10–40	вн	10,1		13	
		08 31 36,5	50,43	157,70	20–40	ав	10,4		13	
		10 18 40,2	50,10	157,02	30–40	ав	11,3	4,9	13	
		10 22 40,3	50,26	157,01	30	аб	9,6		13	
		10 55 59,4	50,45	157,07	0–50	сс	9,9		13	
15		11 32 4[illegible],0	50,10	157,00	60	бв	12,2	5,2	13	
		12 33 09,3	50,40	157,10	10–40	нв	9,9		13	
		12 34 38,2	50,25	157,13	10–40	нв	9,6		13	
		15 08 18,9	50,47	156,98	10–20	вв	9,7		13	
		17 58 17,0	50,22	157,07	10–40	бб	10,0		13	
		20 16 19,0	50,55	157,45	10–20	бв	10,2		13	
		20 35 51,0	50,31	157,16	10	бв	9,7		13	
		20 48 05,0	50,21	157,17	20	бв	9,5		13	
		21 22 57,5	50,31	157,16	10	бв	9,5		13	
		22 01 02,5	50,38	157,17	0–50	сс	10,8		13	

1	2	3	4	5	6	7	8	9	10	11
				March						
	1	02 12 54,0	50,42	157,00	20	ан	9,5		13	
16		02 19 06,0	50,00	157,10	45	ан	12,5	5,1	13	Авача, 2–2,5 балла
		03 01 34,5	50,04	156,71	30	бн	9,8		14	
		04 29 58,0	50,25	157,25	10	ав	10,4		13	
		04 48 46,5	50,04	157,61	0	бв	11,1	4,5	13	
		09 33 12,0	50,10	157,29	20–30	ав	10,7		13	
		10 14 37,5	50,38	156,86	30	ав	10,3		13	
		10 36 17,0	50,25	157,05	20	бв	11,3		13	
		13 46 33,0	50,38	156,86	30	ав	10,0		13	
		16 29 57,5	50,35	157,57	10–20	ан	10,3		13	
		17 04 16,5	50,55	157,51	10	ан	9,6		13	
		22 00 39,0	50,38	156,86	30	ав	10,1		13	
		22 21 02,0	50,56	157,43	20–30	ав	10,2		13	
	2	06 32 47,0	50,59	157,16	40	ан	10,1		13	
		06 53 55,0	50,40	156,98	40	ан	9,8		13	
		07 08 40,5	50,31	156,74	0	вс	10,4		13	
		08 07 50,0	50,34	157,12	20	ав	10,3		13	
		10 24 43,5	50,35	157,24	10	ан	10,5		13	
		11 11 36,0	50,44	157,53	20	ан	11,2		13	
		13 57 01,0	50,37	156,97	20	ан	9,5		13	
17	3	02 42 12,5	50,45	156,96	20	ан	12,2	5,5	13	Авача, 1–2 балла
		06 29 10,0	50,33	157,15	20	ан	9,6		13	
		09 12 08,5	50,28	157,23	10	ан	11,0		13	
		18 27 47,0	50,33	157,15	20	ан	9,5		13	
	4	03 48 44,0	50,08	156,87	0	ан	9,8		14	
		06 59 01,0	50,60	157,45	10	ав	10,8		13	
18		08 28 36,0	50,63	157,65	20	ав	12,2	4,6	13	
		09 29 14,5	50,48	157,03	0	ав	10,6		13	
		11 24 48,8	50,11	157,73	10	бв	10,8		13	
		16 10 13,2	55,62	163,88	20–30	бв	10,0		20	
19		17 57 46,0	54,80	161,70	58	ав	13,4	6,2	7	Авача, 1–2 балла; Петропавловск-Камчатский, 3 балла; Семлячик, 4,5–5 баллов; Апахончич, 2 балла; Ключи, 3–4 балла; Крутоберегово, 4–5 баллов; Паужетка, 2–3 балла
	5	06 15 53,6	50,47	157,63	40	ав	10,7		13	
		10 00 19,0	50,25	156,98	0–50	сс	9,9		13	
		10 14 57,0	50,68	157,45	30	бв	10,0		13	
		19 48 59,0	50,29	157,01	0–50	сс	10,9		13	
		23 44 16,0	56,20	162,69	30	ав	9,8		5	Крутоберегово, 3 балла
	6	02 19 14,5	50,41	157,03	0–10	ав	9,8		13	
		08 29 55,0	50,64	157,41	40	ав	9,6		13	
		18 32 07,3	50,26	157,13	0	бв	10,6	5,0	13	
		20 08 43,2	50,30	157,05	10	аб	9,6		13	
	7	03 31 48,0	50,41	157,07	10	аб	9,6		13	
		17 01 03,4	57,07	156,56	0	бн	9,7		17в	

1	2	3	4	5	6	7	8	9	10	11
	8	03 00 24,4	50,44	156,95	10	ав	9,5		13	
		06 06 28,4	50,30	157,18	0–20	бв	9,6		13	
		14 44 16,3	50,58	157,55	40	ав	10,0		13	
		15 03 20,5	50,37	157,18	0	ав	10,0		13	
		15 18 10,8	50,53	157,42	40	ав	10,1		13	
		20 12 28,0	50,55	157,44	20–30	ав	10,7		13	
		23 13 58,8	50,47	157,47	20–30	аб	9,9		13	
	9	13 58 42,7	50,04	157,24	0–50	сс	10,8	4,6	13	
		14 46 44,4	50,62	157,28	40	аб	9,8		13	
		22 29 36,0	50,38	156,96	10	ав	10,3		13	
	10	04 44 44,8	50,49	157,05	30	ав	11,3	4,7	13	
		06 27 59,6	50,20	157,00	0–50	сс	9,7		13	
		22 34 09,0	50,42	156,97	20	ав	10,2		13	
	11	02 39 05,3	50,28	156,35	90	ав	9,7		14	
		03 17 56,7	55,12	160,87	120–130	аб	9,6		7	
20	12	11 14 22,0	50,07	157,16	0–40	бн	12,8	5,4	13	Паужетка, 3 балла
21		19 39 21,0	50,66	157,48	50–80	бв	14,2	6,1	13	Петропавловск-Камчатский, 4 балла; Семлячик 3–4 балла; м. Шипунский, 3 балла; Авача, 3–3,5 балла; Паужетка, 3 балла
		23 25 44,0	54,73	158,50	300–320	бн	9,9		16	
	13	23 17 28,5	50,12	157,10	10–40	вн	10,0		13	
	15	00 19 21,5	51,11	159,61	10–20	аб	11,2		11	
	18	08 47 46,0	54,47	161,62	30	аб	9,8		7	
		14 50 57,0	56,17	161.18	110	аб	10,2		6	
	19	04 43 51,0	56,00	164,46	20	ав	9,6		20	
	20	00 57 48,5	54,92	162,88	5–10	аб	9,9		7	
		02 46 36,5	50,40	156,98	10–40	нв	10,2		13	
	21	02 24 22,7	50,77	157,40	40	аб	11,4	5,2	13	Паужетка, 2–3 балла
		06 14 19,8	50,18	156,80	0–50	сс	9,6		14	
	22	10 41 02,5	52.80	159,78	0–10	аб	10,7		10	Петропавловск-Камчатский, 2–3 балла
	23	03 59 12,5	50.31	156,89	10–40	вв	11,2		13	
	24	02 50 54,0	50,26	157,16	10–40	вв	10,9		13	
		06 54 59,0	54,35	164,45	40	аб	9,8		20в	
22		07 14 26,0	51,67	161,55	40	ав	11,7	4,8	21в	
		13 05 01,0	55,86	161,35	90	аб	9,5		6	
		14 36 59,5	55,50	162,65	30	ав	10,1		6	
		17 05 17,2	54,98	162,15	30	аа	9,7		7	
23	25	08 56 11,7	50,08	157,16	0–50	вв	12,6	5,4	13	Паужетка, 2–3 балла; Петропавловск-Камчатский, 2 балла
		21 11 04,5	50,40	156,85	0–50	вв	10,7		13	
	26	06 52 05,2	56,49	162,30	10	ав	10,2		5	Крутоберегово, 4 балла
		11 44 13,5	53,70	160,60	40	ав	9,8		9	
	27	13 58 23,4	50,57	157,25	40–50	аб	9,6		13	
	31	17 49 50,8	52,82	159,54	40	аб	9,5		10	
		20 45 31,5	50,31	157,23	0–30	вн	11,2	4,8	13	

1	2	3	4	5	6	7	8	9	10	11
					April					
24	1	08 45 30,0	54,57	162,02	20–30	аб	11,6	4,7	7	
	3	16 19 22,5	50,41	156,92	20–30	ан	9,5		13	
	4	23 18 56,5	55,45	161,16	140	аб	9,8		6	
	7	11 04 45,0	50,38	156,94	0–50	сс	10,3		13	
		15 33 34,5	50,38	156,94	0–50	сс	10,5		13	
	8	06 39 28,0	52,04	158,84	20	ав	10,9	4,3	11	
		12 23 26,5	50,77	157,58	10–20	бв	9,9		13	
	9	08 27 12,0	50,04	156,82	0–50	сс	10,2		14	
		11 52 14,7	52,65	151,83	450	сс	11,0			
		23 00 07,5	56,32	163,20	10–20	вв	9,5		5	
	10	23 56 26,0	50,49	157,45	0–10	бн	9,8		13	
	11	06 03 59,5	55,69	162,41	20	аб	9,5		6	
25	12	12 17 13,5	49,78	156,54	10–40	вн	12,7	5,2	14	
26		13 49 14,5	50,68	157,88	40–60	аб	14,8	6,1	13	Петропавловск-Камчатский, 4 балла
		14 32 34,0	50,80	157,86	40–70	ав	10,7		12	
	13	10 29 34,2	50,72	157,60	20–40	ав	9,5		13	
27		19 16 20,0	53,88	161,75	10	ав	11,7	5,1	8	
	14	06 01 28,0	50,77	157,58	10–40	бв	9,9		13	
		13 46 09,5	53,90	161,75	20–30	ав	9,8		8	
	15	03 13 12,2	50,70	157,67	40	ав	10,8		13	
		05 58 28,3	55,65	161,50	100–110	ав	10,0		6	
28	17	22 10 50,0	50,73	157,85	30–40	аб	12,6	5,6	12	Паужетка, 2–3 балла
		22 21 39,0	50,76	157,64	30–40	ав	10,3		13	
	19	17 40 43,0	55,48	161,73	100–110	аб	10,2		6	
	21	13 49 39,5	50,13	156,78	0–50	нс	9,5		13	
		18 40 35,5	54,58	162,48	5–10	ав	9,5		7	
		19 33 43,8	54,75	162,23	10	ав	9,5		7	
		22 12 11,5	54,80	162,22	20	аб	11,1		7	
	23	18 31 46,5	53,49	162,50	40	аб	9,6		21а	
	24	03 35 32,8	50,11	156,83	10–40	бв	10,0		13–14	
		20 43 39,0	53,80	160,58	40	аб	10,0		8	
	25	02 23 36,6	51,98	159,00	40	аб	9,6		11	
		18 00 05,0	52,97	160,10	40	аб	9,6		9	
	26	09 32 37,0	55,48	162,52	20	ав	9,5		6	
		15 56 48,0	54,20	168,15	0–50	сс	9,7		20б	
	29	09 10 53,0	50,85	157,80	0–40	вв	9,8		13	
		21 36 15,0	56,89	161,91	5–10	аб	10,9	5,0	5	
	30	06 00 26,0	56,84	161,91	10	аб	9,5		5	
		09 20 36,0	56,90	161,85	5–10	аа	9,7		5	
					May					
	1	07 28 28,5	55,71	162,04	70	аб	9,6		6	
		17 17 20,0	50,04	156,80	0–50	сс	10,2		14	
	2	17 00 38,0	54,52	161,88	30	аб	9,9		7	
	3	04 36 38,0	50,70	157,77	40	аб	10,6	4,4	13	
	3	19 43 14,5	50,52	161,41	50–100	сс	10,1		22а	
	4	02 59 17,0	50,48	157,05	40	ав	9,6		13	
	5	23 31 51,0	50,08	156,68	0	бв	9,5		14	
	6	06 18 52,0	56,97	161,82	0	аб	9,7		5	

1	2	3	4	5	6	7	8	9	10	11
29	6	15 11 37,5	53,74	160,73	40	аб	11,8	5,0	8	Петропавловск-Камчатский, 2 балла; м. Шипунский, 2 балла; Кроноки, 4,5 балла
	7	17 57 15,0	50,00	156,83	0–50	сс	9,5		14	
	8	01 40 50,5	52,05	159,10	40	бб	10,0		11	
	10	03 00 51,7	55,19	162,90	30–40	аб	9,9		6	
		07 25 33,0	54,58	162,07	20–30	аб	10,7		7	
		19 16 20,5	50,49	157,60	10	ав	10,6	4,9	13	
	11	03 18 05,0	51,44	158,55	40	аб	10,2		12	
	12	00 30 02,7	54,63	161,68	40	аб	10,2		7	
		09 20 07,3	49,96	156,65	10–40	вв	9,8		14	
	13	12 03 57,3	50,53	157,03	0	ав	10,5		13	
	15	18 26 01,7	52,09	158,75	60	аб	9,9		11	
	17	00 46 41,0	53,91	162,21	10	аб	10,0		8	
	18	07 37 50,0	54,00	161,42	30	аб	9,8		8	
	20	18 47 17,0	50,18	157,15	20–40	бб	9,5		13	
	21	22 19 10,3	55,67	160,25	200	бб	10,6		17б	
	22	20 57 21,8	55,73	163,91	0	аб	9,6		20б	
	23	10 15 12,7	53,98	168,95	0–50	сс	9,7		20б	
		21 20 54,2	55,82	161,20	120	аб	9,5		6	
	25	20 44 48,0	55,21	164,91	40	аб	11,2		20б	
	29	20 05 31,0	52,93	159,65	40–50	аб	10,2		10	
		23 07 09,0	54,95	163,87	40	ав	11,1		20б	
	30	20 20 11,3	55,05	162,18	40	аб	9,5		7	
						June				
	2	13 12 46,0	55,38	166,24	30–40	бв	10,6		20б	
	5	10 53 56,0	50,47	157,00	10	ав	9,8		13	
	6	16 28 01,0	50,10	158,18	10–50	нк	10,1		13	
	8	12 21 28,5	51,00	158,00	40	бв	10,8		12	
		17 18 47,0	54,96	159,57	0	ав	10,4	4,3	17а	
		21 19 57,5	55,79	163,95	20	аб	11,2	4,3	20б	
30	9	01 37 25,0	53,73	160,65	40	аб	12,1	5,0	8–9	Семлячик, 4,5 балла; м. Шипунский, 3 балла; Авача, 3–4 балла; Кроноки, 4 балла; Карымский, 3 балла
		04 54 21,2	53,75	160,70	30	ав	10,7		8	Семлячик, 3–5 баллов; Авача, 3–4 балла; Кроноки, 3 балла
		08 37 59,0	50,68	157,55	30–40	ав	10,0	–	13	
31		22 46 01,0	52,96	160,16	40	ав	12,0	5,0	9	Семлячик, 3–5 баллов; Петропавловск-Камчатский, 3 балла; м. Шипунский, 3 балла; Авача, 3 балла; Кроники, 3, 5 балла; Паужетка, 3 балла

1	2	3	4	5	6	7	8	9	10	11
		22 56 06,0	57,06	163,24	0	ав	10,6		4	
		23 58 49,0	52,96	160,16	40	аб	10,5		9	
	10	04 13 46,0	52,89	160,21	30–40	аб	9,5		9–10	
32	11	08 42 04,0	53,50	161,75	45	аб	12,7	6,5	8	Семлячик, 4–5 баллов; Петропавловск-Камчатский, 3–4 балла; Кроноки, 5 баллов
		08 56 30,2	53,47	161,95	10	аб	10,4		8	
		10 44 11,5	53,45	161,77	10	аб	9,8		8	
		13 07 58,0	53,50	161,78	10	аб	10,4	8		
		15 50 52,5	53,55	161,75	10	аб	9,7	8		
		18 06 56,5	53,47	160,56	40	бб	9,6	9		
	12	00 26 12,0	53,50	161,88	20	аб	10,3	4,2	8	
		01 09 28,0	53,55	161,78	10	аб	10,5	4,2	8	
		01 34 18,0	53,48	161,88	20	аб	9,7	4,2	8	
		02 01 56,0	53,55	161,78	10	аб	9,5		8	
		03 36 54,0	53,56	161,81	10	аб	10,9	4,5	8	
		04 41 03,5	53,47	161,70	10–20	аб	9,9		8	
		06 43 59,0	53,47	161,68	10–20	аб	11,1	4,8	8	
		08 41 58,0	53,40	161,68	20–30	аб	9,7		9	
		11 08 25,5	53,46	161,60	10–20	аа	9,6		8–9	
33		14 21 22,6	53,53	161,67	10–20	аб	12,8	5,8	8	Семлячик, 4 балла; Петропавловск-Камчатский, 3 балла; Карымский, 3 балла
		14 36 24,4	53,60	161,62	20	аб	9,5		8	
		14 48 21,1	53,53	161,67	20	аб	10,2		8	
		14 53 16,1	53,59	161,59	20	ав	10,5		8	
		15 43 00,0	53,48	161,71	20	ав	9,5		8	
	13	13 40 48,7	53,49	161,80	10	аб	10,3	3,9	8	
		16 00 55,0	53,43	161,62	20	аа	10,1		9	
34	15	11 20 46,0	53,37	161,40	54	аб	12,6	6,2	9	Семлячик, 3 балла; Петропавловск-Камчатский, 4 балла; м. Шипунский, 2 балла; Ключи, 2 балла; Карымский, 3 балла
		11 42 54,8	53,42	161,67	10	аб	9,6		9	
		11 56 22,0	53,39	161,73	20	аб	10,3	4,7	9	
		12 13 26,7	53,44	161,64	20–30	аб	10,3		9	
		12 47 16,5	53,49	161,71	20	аб	9,9		8	
		13 16 53,2	53,51	161,95	20	аб	11,3	5,1	8	
		13 44 37,0	53,57	161,79	40	ав	9,6		8	
		17 17 10,0	53,49	161,44	20	ав	10,2		9	
		18 04 53,2	54,40	162,93	40–50	ав	10,3		20в	
		20 56 31,0	53,42	162,00	20	ав	10,9		8	
35		21 09 38,5	53,52	161,63	10	ав	12,5	5,7	8	
	16	02 06 39,5	53,54	161,51	10–20	аб	10,4		8	
		04 06 37,0	53,51	161,55	10–20	аб	9,9		8	
		05 18 22,0	53,47	161,67	20	ав	9,7		8	
		18 35 24,0	53,43	161,67	10–20	бб	11,0	4,7	8–9	
		19 49 29,4	53,42	161,65	30	аб	10,5	4,9	9	

1	2	3	4	5	6	7	8	9	10	11
	16	20 34 06,5	53,32	161,76	20	аб	10,4	4,8	9	
36	17	07 43 28,0	53,35	161,77	20–30	аб	11,5		9	
		09 18 06,5	53,54	161,36	40	аб	9,7		8	
	21	01 30 26,5	50,54	157,05	10	ан	9,7		13	
		10 56 15,5	52,89	159,55	10	ав	10,0		10	
	22	04 20 13,0	52,35	160,68	20	аб	10,7		10	
	23	05 28 05,5	51,31	159,63	0	бн	9,5		11	
		10 06 05,5	54,50	161,55	40	аб	10,4		7	
		13 46 05,5	50,83	157,97	40–60	ав	10,1		12	
		17 13 13,0	51,15	158,12	10–40	ав	9,8		12	
	24	11 51 07,5	53,41	161,66	30	аб	10,0		9	
	26	20 14 49,0	50,48	157,10	0–40	сс	9,9		13	
37	27	11 50 41,0	52,90	160,04	30–40	аб	11,5	5,0	10	Петропавловск-Камчатский, 3 балла; м. Шипунский, 3 балла; Кроноки, 3 балла
	28	01 41 47,0	55,90	163,06	10–20	аб	10,4		6	
	29	02 29 36,0	53,72	160,75	40	аб	10,1		8	
		06 49 56,5	50,99	158,25	40	ав	11,2		12	
		15 39 02,5	54,84	164,05	40	ав	9,6		20б	
		18 44 05,5	52,97	158,59	20	ав	10,1		11	Петропавловск-Камчатский, 3–4 балла; Авача, 4,5 балла

July

	1	15 29 16,5	50,29	157,35	20–30	ав	10,1		13	
38	2	05 56 12,6	54,11	163,94	40	ав	11,9	5,0	20в	
		14 36 05,0	53,20	159,95	40–50	аб	10,4	4,2	9	Петропавловск-Камчатский, 2 балла; м. Шипунский, 3 балла
	3	06 11 22,6	52,38	160,54	10	аб	9,9		10	
	4	07 53 29,0	50,11	156,94	0–50	сс	9,5		14	
		19 53 24,0	53,65	160,75	40	ав	9,6		9	
	5	02 40 51,5	50,06	156,76	0–50	сс	9,7		14	
		02 50 37,5	56,10	162,26	10	ав	10,1		5–6	
		05 59 01,7	51,30	159,92	30	ав	10,2		11–22а	
	6	00 15 08,0	51,14	160,06	20–30	ав	9,9		22а	
39		23 38 34,5	50,44	156,93	40–60	вв	12,2	4,5	13	Паужетка, 3 балла
	7	08 29 10,0	50,30	157,34	10–40	нн	9,8		13	
	8	18 54 25,9	53,57	160,55	40	ав	10,6	4,7	9	Кроноки, 3 балла
	9	02 04 10,0	54,42	158,40	0	ав	11,2	4,5	16в	Петропавловск-Камчатский, 2 балла
	10	08 32 43,2	51,30	159,72	20	бв	10,5	4,2	11	
		08 34 46,7	51,37	159,60	20–40	вв	10,9		11	
40		09 09 34,4	51,42	159,72	20	ав	11,6		11	
	11	03 30 51,4	50,68	157,65	100	сс	10,0		13	
		12 03 53,5	50,15	157,05	100	бв	10,1		13	
		21 31 21,5	53,59	159,97	90–100	аб	10,3		9	
	12	14 28 03,5	50,52	154,48	220	нн	10,2		15а	
	13	11 54 22,2	55,84	164,28	20	ав	10,8	4,3	20а	
	14	08 45 10,5	54,87	165,65	20	бв	9,8		20б	
		12 55 15,7	55,68	162,20	20	аб	10,2		6	

1	2	3	4	5	6	7	8	9	10	11
41	16	20 45 27,0	54,97	161,13	90	аб	12,1	4,7	7	Кроноки, 4–5 баллов
	19	10 11 55,0	54,38	160,12	120	ав	9,8		8	
	23	00 34 47,5	52,15	157,91	150–160	бб	11,2	4,8	11	
		09 00 26,0	50,26	157,15	10–40	нв	10,2		13	
		10 11 13,5	50,20	157,03	10–40	нн	9,7		13	
	24	12 17 14,5	55,71	161,36	100	аб	9,7		6	
		19 10 02,0	54,22	168,80	0	бб	10,9		20б	
	25	03 43 28,0	52,98	158,96	100–110	бб	9,9		10	
	29	13 41 35,5	50,52	156,97	10–40	вн	9,8		13	
August										
	1	17 14 00,0	54,60	162,57	10	бв	9,7		7	
		18 36 09,5	54,58	162,63	10–20	аб	10,8		7	Кроноки, 3 балла
	2	07 12 49,0	52,45	159,02	30	аб	10,9	4,6	10	
	3	09 14 50,0	55,47	161,10	120–130	аб	9,7		6	
42		17 23 52,5	54,61	162,60	0	бв	13,0	6,0	7	Кроноки, 4,5 балла; Семлячик, 4 балла
		17 31 42,0	54,40	162,80	20	ав	11,0		7	
43		17 35 19,6	54,66	162,56	5–10	нн	11,8		7	
		17 46 20,5	54,66	162,56	5–10	ав	11,2	4,8	7	
		17 53 29,5	54,66	162,56	5–10	бв	10,8		7	
		18 07 33,0	54,59	162,60	5–10	ав	9,6		7	
		18 38 41,7	54,56	162,60	5–10	аб	9,9		7	
		19 06 30,4	50,15	157,44	0–50	сс	9,6		13	
		20 38 42,0	54,51	162,61	5–10	аб	9,8		7	
		21 07 53,0	54,58	162,55	0–10	ав	9,7		7	
		23 19 14,8	54,53	162,70	5–10	ав	11,4	4,7	7	
	4	00 54 12,4	54,48	162,66	20	ав	9,9		7	
		00 57 38,0	54,49	162,62	5–10	ав	9,7		7	
		02 08 29,5	54,53	162,75	0–10	ав	10,4		7	
		04 30 51,5	54,49	162,64	10	вв	9,9		7	
		08 03 46,7	53,78	163,77	40	ав	10,8	4,3	21а	
		11 36 45,8	54,53	162,59	10	ав	9,5		7	
	5	10 34 44,5	53,67	160,13	70–80	аб	9,5		9	
		16 47 16,0	54,55	162,54	10–20	ав	9,6		7	
		19 12 47,5	51,45	158,25	40–60	бв	10,1		12	
	6	09 45 40,0	55,98	161,13	150–160	аб	11,0	4,2	6	
	10	05 19 51,0	56,05	163,23	10–20	бв	9,8		5	
	11	06 54 55,5	54,39	162,75	20	ав	9,8		7	
		07 37 11,0	54,25	161,85	10	аб	9,5		8	
	12	06 35 33,5	55,37	164,43	40	вв	10,0		20б	
	14	01 42 31,5	50,36	157,05	0	сс	9,9		13	
	17	03 20 28,5	55,44	166,15	30	бв	9,5		20а	
	18	10 52 39,5	54,52	163,59	40	ав	10,3		20в	
	19	00 14 43,0	54,08	161,57	40	ав	10,0		8	
	21	09 18 40,5	50,21	157,13	40–90	вв	10,1		13	
44	25	12 15 50,5	56,07	163,68	5–10	аб	11,7	5,1	5	Крутоберегово, 4–5 баллов
	26	01 16 54,5	50,28	156,98	10–40	бв	9,7		13	
		22 45 29,5	55,07	164,24	40	бб	9,9		20б	
	29	00 34 44,5	55,80	163,73	40	ав	10,6		20в	

1	2	3	4	5	6	7	8	9	10	11
				September						
	2	01 29 41,5	55,00	165,52	20	бн	9,7		20б	
		17 29 01,4	53,17	160,15	40	аб	9,7		9	
	3	12 15 56,5	50,36	156,91	40	ав	9,8		13	
	5	10 50 04,0	51,98	160,97	5–10	аб	10,1		21в	
	6	03 41 41,0	51,82	160,00	0	ав	9,9		11	
	8	00 08 39,0	57,65	163,25	0–10	ав	9,5		4	
	14	21 15 28,0	50,98	157,60	30	бб.	10,7		12	
	17	00 10 12,3	51,67	158,76	30–40	бб	10,3		11	
	19	23 48 27,7	50,57	156,98	10–40	бв	9,6		13	
	20	05 21 47,4	54,95	163,72	40	ав	10,3		20б	
	21	09 29 07,3	53,35	161,65	10–20	ав	10,5	4,0	9	
	22	12 51 48,5	50,85	158,20	10–40	вв	9,5		12	
	23	02 19 59,5	54,45	162,00	30	бб	10,8	4,5	7	
		19 14 01,0	51,42	157,28	140	ав	10,8		12	
	26	10 15 18,5	52,82	158,20	140	бв	9,5		10	
		12 21 46,0	50,40	157,00	30	нн	9,5		13	
	28	20 19 37,5	52,84	162,19	30	бв	9,7		21б	
	29	20 27 55,5	51,83	160,21	0	ав	11,4		11	
				October						
	1	11 54 14,0	52,96	160,25	30–40	ав	9,6		9	
	2	21 46 45,5	54,47	162,05	20–30	аб	9,6		7	
	5	02 51 31,5	56,22	164,30	20	ав	9,6		20а	
		06 07 24,0	53,43	158,88	140–150	бб	9,9		9	
	6	17 12 02,0	50,41	156,77	40–60	ав	11,2		13	
		21 43 15,0	53,68	160,75	40	аб	10,3		9	
	7	04 08 56,7	53,60	160,67	40	ав	9,7		9	
		11 56 47,5	54,44	162,35	20	ав	10,2		7	
		15 07 00,5	50,60	157,07	40–50	ав	10,5		13	
		18 47 21,9	50,44	156,83	10–40	нн	10,1		13	
	8	06 21 01,7	50,24	156,68	40	бн	9,5		14	
		07 48 34,3	50,55	156,18	90	бн	9,8		13	
	9	18 07 15,0	51,10	160,40	10–40	вв	11,2		22а	
		19 48 20,5	52,58	159,50	30	аб	10,7		10	
	10	04 41 34,5	55,48	162,40	20	ав	11,4	4,6	6	
		06 01 24,0	54,47	161,87	30–40	аб	9,7		7	
		11 44 26,7	54,37	158,45	0	бб	10,3		16в	
	11	15 35 31,5	53,40	167,87	0	бн	9,9		20в	
	12	03 03 10,5	50,12	161,30	40	бн	9,9		22б	
		19 58 05,8	54,24	161,71	30	аб	9,5		8	
	14	23 34 41,5	52,21	158,37	170	ав	10,1		11	
	16	13 36 24,2	54,45	161,83	30	ав	10,4		7	
	17	13 26 04,7	50,39	157,53	30–40	бв	10,0		13	
	18	08 50 27,0	50,28	156,87	40–50	бв	9,5		13	
		19 24 06,0	55,28	162,15	30	аб	10,0		6	
	21	03 31 50,0	53,35	160,02	60	ав	9,7		9	
	22	22 09 19,3	50,12	157,11	40	бн	9,5		13	
	23	04 59 48,5	54,43	161,52	50	аб	10,4		8	
		05 09 15,4	51,62	159,30	10–20	бв	10,9		11	
		09 25 28,0	55,73	163,92	0–10	ав	9,6		20б	

1	2	3	4	5	6	7	8	9	10	11
45	24	04 43 25,7	56,23	163,02	20	ав	11,8	4,6	5	Крутоберегово, 4 балла
46	26	03 23 07,5	56,33	163,05	20	ав	11,6	4,4	5	Крутоберегово, 5–6 баллов
	27	17 43 38,5	53,53	160,58	20–30	ав	9,5		9	
	28	00 03 04,0	55,77	163,60	10–20	ав	9,5		6	
		07 16 45,0	50,48	157,02	10–40	вв	9,6		13	
47	29	00 39 15,8	54,97	162,32	0	ав	11,9		7	
		18 49 02,0	53,79	160,58	40	ав	10,5		8	
	30	01 01 39,5	55,10	165,25	0–10	бв	9,5		20б	
		12 23 36,5	56,10	162,45	0	ав	9,9		5	
		17 43 45,0	54,44	162,77	20	аб	9,5		7	
		18 20 09,5	55,18	162,39	20	ав	9,6		6	
					November					
	1	17 51 48,5	51,12	160,32	0	бн	9,8		22а	
	2	00 32 30,0	50,10	156,70	0–50	сс	11,3		14	
		04 05 38,0	53,22	169,30	0–50	сс	10,6		20в	
48	3	00 19 50,5	54,52	161,54	40	ав	12,8	5,3	7	
		10 18 58,5	50,45	157,06	40	ав	9,6		13	
		18 53 38,5	55,47	162,58	5–10	ав	10,2		16	
	4	19 59 01,0	52,61	160,65	20–30	ав	11,2	4,8	10	
		22 46 35,5	52,39	160,63	0	аб	9,8		10	
	6	21 38 25,5	55,75	163,83	10–20	бв	9,5		20б	
	7	13 44 36,0	50,21	157,41	40	ав	10,7		13	
		17 11 30,0	53,21	153,24	450	сс	9,7			Охотское море
49	8	08 59 12,0	50,00	156,76	0–60	сс	15,4	6,0	14	Паужетка, 3 балла; Петропавловск-Камчатский, 4 балла
50		09 02 43,0	50,00	156,76	0–30	сс	12,9		14	
		16 53 02,0	50,06	156,85	10	ав	10,3		14	
		18 56 31,0	49,89	157,07	0–40	сс	9,8		14	
		19 30 16,5	53,88	160,20	90	аб	9,9		8	
	9	05 58 21,0	51,00	157,94	40	ав	11,1		12	
	10	20 42 39,0	56,55	161,40	80	аб	11,2		5	
51	11	02 43 07,0	50,05	156,87	0–50	сс	13,5	6,0	14	Паужетка, 2 балла
		02 50 31,0	50,05	156,87	0–50	сс	10,5		14	
		03 33 43,5	50,05	156,87	0–50	сс	10,4		14	
		04 31 59,7	53,86	150,56	40–50	аб	10,0		8	
		09 13 50,5	53,24	162,91	40	бв	10,3		21а	
		18 23 48,7	51,92	157,86	140–150	аб	10,0		11	
52	17	05 45 02,5	54,32	169,16	20	бв	12,0	4,8	20б	
		22 09 41,5	50,97	157,27	60–80	вв	10,9		13	
		23 17 18,0	50,36	157,28	10–40	вв	9,7		13	
	18	01 42 38,5	53,61	160,86	20	аб	10,3		9	
		03 40 40,5	54,77	161,70	5–10	аб	9;6		7	
		08 14 26,0	49,9[illegible]	156,48	40–90	сс	9,5		14	
	19	01 36 01,5	52,08	159,34	30	аб	10,5		11	
	20	13 42 09,5	53,91	159,98	110	аб	9,6		9	Кроноки, 3-3,5 балла; Петропавловск-Камчатский, 3 балла

1	2	3	4	5	6	7	8	9	10	11
53		16 57 34,5	52,42	160,80	0–10	бб	12,5	5,4	10	
		17 18 59,0	52,38	160,54	10	бб	10,1		10	
	21	03 10 13,0	56,06	164,18	10	аб	9,6		20а	
		17 38 59,5	54,83	164,09	40	ав	9,9		20б	
		21 03 40,6	56,46	162,10	60–70	бв	9,7		5	
		23 25 21,8	50,22	157,08	0–20	вв	11,0		13	
	22	20 07 06,5	52,22	160,00	0–10	вн	9,8		10	
	23	02 35 04,6	52,42	160,75	0	ав	9,7		10	
	23	03 07 22,5	52,49	160,80	0–5	бв	9,5		10	
		07 43 18,0	52,43	160,78	10–20	аб	9,5		10	
	24	01 15 16,5	52,82	159,60	40	аб	9,9		10	Петропавловск-Камчатский, 2 балла
	25	05 01 35,0	55,08	159,54	10	ав	9,7		17а	
	26	07 00 34,0	54,50	161,54	70	аб	9,6		7	Кроноки, 4,5 балла
		18 06 30,0	52,45	159,40	20	аб	10,7		10	Петропавловск-Камчатский, 2–3 балла
		22 50 19,5	51,33	157,00	0	бн	10,0		12	
54	27	13 52 28,0	53,47	160,80	40	аб	13,9	5,9	9	Петропавловск-Камчатский, 3–4 балла; Авача, 3,5 балла; Карымский, 4–5 баллов; Кроноки, 4,5 балла
	28	15 16 21,0	52,70	160,85	10	ав	10,2		9–10	
55	29	17 59 13,5	53,08	152,58	450–500	нн	13,7	5,2		Кроноки, 4–5 баллов

December

1	2	3	4	5	6	7	8	9	10	11
	1	01 59 18,3	50,10	157,05	10–40	вн	10,0		13	
	2	15 47 49,5	52,94	160,00	30	аб	9,7		10	
	3	08 16 42,5	53,42	160,30	30	аб	9,5		9	
		22 24 38,0	54,43	161,98	30	ав	10,0		7	
	4	15 26 01,3	51,27	158,42	50	аб	10,1		12	
	6	02 28 37,0	53,65	161,00	40	ав	10,4		8	
56	9	07 27 47,5	50,35	156,98	10–40	вв	12,0	4,9	13	
		23 02 01,5	53,83	161,00	30	ав	10,3		8	
	13	13 14 08,1	49,87	157,65	0–50	сс	10,9		13	
	15	19 45 57,6	50,38	156,77	40	ав	11,1		13	
	16	21 17 08,5	50,41	157,60	40	ав	9,8		13	
	19	01 56 15,7	54,37	162,10	20–30	ав	9,7		7	
	20	00 21 41,3	53,25	160,07	40–50	ав	9,8		9	
		08 23 10,5	50,67	157,36	10	ав	9,5		13	
	21	15 11 53,4	50,55	157,05	10–40	бв	11,3		13	
		17 58 02,8	53,17	160,44	30–40	ав	10,0		9	
	22	09 59 49,5	53,04	160,02	40–50	ав	9,5		9	
	23	17 06 42,7	50,02	156,80	10–40	нн	9,7		14	
	24	04 59 50,8	53,64	150,58	40	аб	9,8		9	
	25	02 54 06,5	53,74	161,10	20	аб	10,6		8	
	26	15 06 17,0	52,41	160,79	10–20	аб	9,5		10	
	27	02 06 39,5	52,46	160,71	10	аб	10,2		10	
	29	06 10 12,0	53,40	160,39	20–30	аб	9,7		9	
		06 11 26,5	53,40	160,35	30	ав	9,5		9	

1	2	3	4	5	6	7	8	9	10	11
57		08 20 09,0	54,44	168,97	40	бв	12,8		206	
		10 24 27,5	54,37	168,23	20	бв	10,5		206	
		13 22 58,2	52,93	159,83	40	ав	10,2		10	
		19 31 00,7	52,80	158,78	90	бв	10,1		10	
	30	17 31 42,0	55,13	161,61	90	аб	9,8		76	
	31	05 48 11,5	51,60	160,10	0	вн	10,0		11	

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IN IN

17 OCTOBER 1979 (FOUO) 3 OF 4

EARTHQUAKES AT SAKHALIN

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The article is devoted to the results of processing materials from instrument observations of earthquakes in Sakhalin, obtained at permanently operating seismological stations. The principal parameters of the seismic equipment for these stations, as well as the area of recording earthquakes of varying energy level in the Sakhalin zone by any three permanently operating stations are given in work [1]. In the period from July to September 1973 a field-type temporary station was in operation at the settlement of Utesnoye (40 kilometers southeast of the city of Yuzhno-Sakhalinsk), which was equipped with SKM-3 seismometers (vertical channel, amplification 50,000) and VEGIK (two horizontal components, amplification 10,000 and 20,000). The materials of the observations of this station were used in processing the Sakhalin earthquakes. Naturally, when earthquakes with $M > 4$ were processed, observations were used from all the stations in the Far East, USSR and the world at which these underground jolts were registered.

The epicenters of the Sakhalin earthquakes were determined in 1973 with the same methods as in 1970-1972. In this case the energy classification of the earthquakes was made according to the travel time curve of S. L. and O. N. Solov'yev [2]. The boundaries between the conditionally singled out regions into which the Sakhalin zone was divided, and their numbering are presented in figs. 1 and 2 (for designation of the conditional regions, see [1]).

The basic parameters of the Sakhalin earthquakes with $K \geqslant 8$ with focal points within the earth's crust (thickness of the earth's crust is assumed to be 33 km) were included in the catalog. The parameters were determined for a total of 139 earthquakes in the Sakhalin zone, including underground jolts in the adjacent sections of Khabarovskiy Kray, and their distribution by energy level in 1972 and 1973 is given in the table.

The distribution of the epicenters of the Sakhalin earthquakes with $K \geqslant 8$ is shown in Figure 1, and with $K < 8$--in Figure 2.

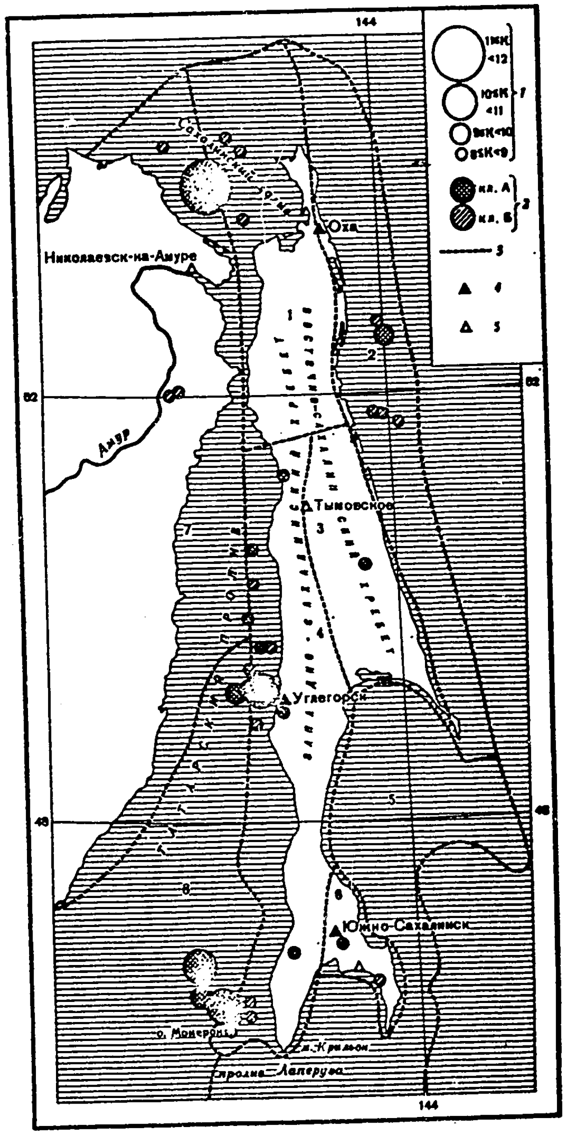

Figure 1. Map of the Epicenters of Earthquakes in Sakhalin With K $\geqslant 8$

1--energy of earthquakes; 2--accuracy of determining epicenter; 3--boundaries of seismoactive regions; 4--permanently operating seismological stations; 5--temporary stations

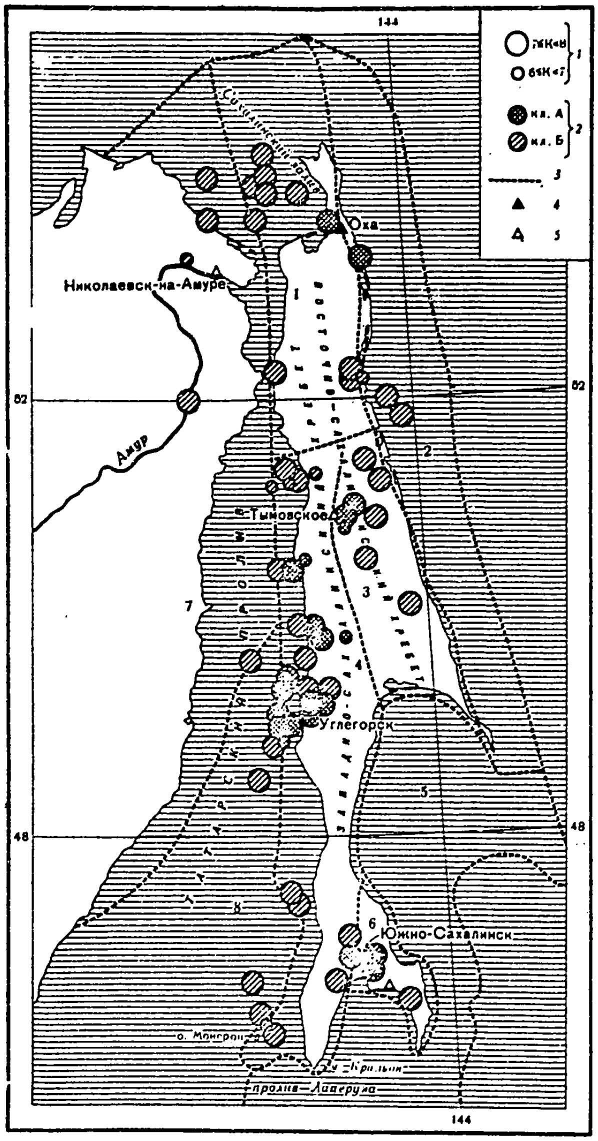

Figure 2. Map of the Epicenters of Earthquakes in Sakhalin With K< 8.

For conventional designations see Fig. 1.

Distribution of Earthquakes by Regions and Energy Level in 1972-1973

(1) № района	(2) Год	6>M≥5	11>K≥10	10>K≥9	9>K≥8	8>K≥7	K<7	(3) Всего
1	1972	–	1	–	4	3	2	10
	1973	1	–	–	4	10	1	16
2	1972	–	1	–	1	7	4	13
	1973	–	–	1	4	3	1	9
3	1972	–	–	–	3	8	1	12
	1973	–	–	–	1	7	–	8
4	1972	–	–	1	4	8	10	23
	1973	–	2	2	23	47	9	83
5	1972	–	–	–	–	–	–	–
	1973	–	–	–	–	–	–	–
6	1972	–	–	–	–	3	2	5
	1973	–	–	–	2	3	4	9
7	1972	–	–	–	–	1	1	2
	1973	–	–	–	3	3	1	7
8	1972	–	1	–	15	15	13	44
	1973	–	1	2	–	4	–	7
Всего (3)	1972	–	3	1	27	45	33	109
	1973	1	3	5	37	77	16	139

Key:

1. Number of region
2. Year
3. Total

With respect to both the number of underground jolts and to the greatest magnitude of the earthquake, the overall level of seismic activity in the Sakhalin zone in 1972 was relatively low, although higher than in 1972. One earthquake with a magnitude of 5 and four with M=4.0-4.7 were recorded during the year.

The strongest earthquake in the Sakhalin zone occurred on 4 November at 13:01 Greenwich time (see catalog) om Sakhalin Bay on the boundary of the first and seventh conditional regions. Its magnitude was 4.7 and the depth was 20-30 kilometers. According to the data from instrument observations from 1909-1972, no such strong earthquakes had been recorded in Sakhalin Bay.

The Northern Sakhalin earthquake was felt at a number of population centers adjacent to sections of Northern Sakhalin and Khabarovskiy Kray with an intensity of 3-4 points (Fig. 3). According to the instrument data for this earthquake, using N. V. Shebalin's method [3], theoretical circular isoseismal lines were plotted. For this purpose, the coefficients for the equations of the macroseismic field had been determined earlier for eight Sakhalin earthquakes: b=1.6, S=4.3 and c=3.3. Then, according to the formula

$$I_i = bm - S \lg D_i + c$$

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for M=5 the hypocentral distances D_i were calculated. The radii of the isoseismal lines, r_i, were determined from the expression

$$r_i = \sqrt{D_i^2 - h^2},$$

where h is the instrument depth, equal to 30 km.

The radii of the isoseismal lines were obtained, r_5=25 km, r_4=60 km, r_3=110 km.

The theoretical isoseismal lines were plotted in the form of concentric circles with the center at the instrument epicenter (see Fig. 3). There is a completely satisfactory agreement between the intensity at the population centers and the theoretical isoseismal lines of the third and fourth points.

The earthquake on 4 November was preceded and accompanied by a series of weak underground jolts. For example, during 1972, earthquakes with $K < 9$ occurred east of the epicenter no closer than 70 kilometers from it. In 1973 underground jolts were recorded both east and west, and at distances of 30-75 kilometers. The last preceding underground jolt was registered 20 hours before the main earthquake. As can be seen from the catalog, the epicenters of all the repeat jolts in the course of 1973 were located only east of the epicenter of the main earthquake at a depth of 5-20 kilometers within the limits of the isoseismal lines of the fourth point; their energy class was not above 8.5.

The second special feature of the seismic conditions in the seventh conditional region is the occurrence of three underground jolts with K=7-9 in the region of the lower reaches of the Amur River (at a latitude of the 52d parallel); in 1971-1972 no such earthquakes were recorded here, even though the system of instrument observations was the same.

In other parts of the first region, the epicenters of weak ($K < 8$) single earthquakes were recorded northwest of Okhi, on the western coastal region of Sakhalin, opposite Lazareva Cape, north of Nogliki Point.

The seismicity in the second conditional region was somewhat lower than in 1973. Here three earghquakes with K=8-9 were recorded east of the epicenter of the Norlik skiy earthquake in 1964, and two with K=8-10 northeast of it, while in 1972 they occurred primarily southeast of Okhi. In 1973 only one epicenter of an earthquake with K=7-8 was recorded southeast of Okhi.

In the region of the Eastern Sakhalin Range (third region), the seismicity in 1973 was lower than in 1972. Here only one earthquake with K=8-9 was recorded (in 1972--three); the rest of the underground jolts had an energy class lower than 8, and their epicenters were located northeast and southeast of the settlement of Tymovskoye.

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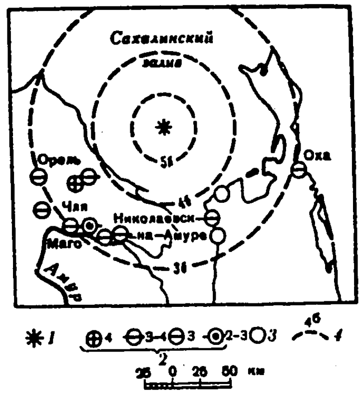

Figure 3. Diagram of the Surface Effect of the North Sakhalin Earthquake on 4 November.

1--epicenter according to instrument data; 2--intensity; 3--earthquake not felt; 4--theoretical circular isoseismal lines

Just as in 1972, in the fifth conditional region not even earthquakes with K=6-7 were recorded.

The seismoactivity in the sixth region was somewhat higher in 1973: here two earthquakes with K=8-9 were recorded, and a series of weaker ones in the region of South Sakhalin and southeast of it.

In the aftershock area of the Moneronskiy earthquake, which occurred in September 1971, repeat jolts continued in 1973. Two of them had a magnitude of ~4.5, and were felt by the population of Moneron Island with an intensity of up to 4 points (see catalog, 4 June and 2 August). The general seismicity of this area was approximately the same as in 1972.

As compared with 1972, an increase in the seismic activity in the northernmost part of the fourth conditional region was noted (northwest of the settlement of Tymovskoye). An earthquake with K=8.5 was recorded here, and a series of weaker underground jolts, while in 1972, one underground jolt with K=7 was recorded in this region.

With respect to its manifestation at the surface, the strongest earthquake in Sakhalin occurred on 6 February 1973 at 20:46 Greenwich time, 20 km northwest of the city of Uglegorsk. Its magnitude was 4.5 and the focal depth was 10-20 km. The Uglegorsk earthquake was felt with the greatest intensity of 6-7 points in the cities of Shakhtersk and Uglegorsk and the settlement of Udarnyy. An operations detachment of the Sakhalin Complex Scientific Research Institute, which included D. I. Lazarenko, V. V. Ovchinnikova, A. P. Liseyenko, A. M. Khantayeva and N. I. Kazarez was set up to gather macroseismic data on the manifestations of the earthquake in

[redacted]

the population centers. N. Yu. V'yunova and Kim Khen Son also assisted in investigating the aftereffects of the earthquake. Under the difficult conditions of the Sakhalin winter they gathered information at the population centers along the railroad from Yuzhno-Sakhalinsk to Pobedino. Given below is a brief description of the surface effect of the Uglegorsk earthquake at certain population centers.

Uglegorsk. The earthquake was felt differently in different parts of the city, and its intensity varied from 5.5 to 7 points. In the northwest (from the seacoast to the center of the city) section, in wooden one- and two-story houses, located on weak ground, many cracks appeared in the wall and ceiling plaster, sometimes up to 5 cm thick. Up to 50 percent of the brick chimneys were destroyed; in some houses the ovens separated from the walls by up to 1 cm, and cracks appeared in the ovens themselves. In one of the dilapidated wooden houses, chests of drawers fell toward the west. The earthquake was scarcely, weakly felt in the northern and northeastern parts of the city. Here too, however, cracks were noted in the plaster of frame-fill houses; brick chimneys were damaged and fell in some cases, and fine cracks appeared in the ovens. In the other parts of the city the earthquake was manifested more weakly. Most of the inhabitants of Uglegorsk heard an underground rumble and noticed the appearance of the earthquake in the form of sharp, gradually intensifying jolts lasting 3-15 seconds; no one noticed even vibrations of the soil.

Svetlyy Put'. The settlement is located north-northwest of Uglegorsk, on the shore of the Tatarskiy Straits; the ground is alluvial sand. This is how eyewitness V. V. Shupirkin describes the manifestation of the earthquake: "I was sitting at a table in a one-story log house. A sharp jolt ("report") was heard, and I sprang up from the chair; at the same time a roar like the wind was heard and the sharp shaking continued. The first jolt came as if from below, and then the vibration was from north to south and continued for 7-10 seconds. The walls and ceiling could be heard creaking; the whitewashing crumbled and small pieces of plaster fell from the finishing of the oven, the oven itself cracked and the chimney didn't fall from the sheet iron. The partition separating the kitchen from the room separated from the south wall of the house by 5 cm." Cracks in the plaster of the walls and the ovens 0.3-0.8 cm thick were noted in many wooden houses made of logs and frame-filled houses; there were cases of glass breaking, apparently due to the skewing of the window frames. In one of the houses the oven burner split off and fell into the southeast corner, and in another the top of one wall "came away" to the east, and of the opposite--to the west. The intensity of the earthquake in the settlement is estimated at 7 points.

The settlement of Udarnyy (northeast of Uglegorsk). In wooden, barracks-type houses, the brick chimneys were destroyed; slight (in rare cases moderate) damage to the ovens and cracks in the wall and ceiling plaster were observed, light (sometimes heavy) objects fell from high stands.

[redacted]

Similar damage was also noted in somewhat lesser amounts in wooden houses made of beams. In the settlement snow fell into the drain gutter (100 m long and 0.5 m wide), and cracks 1-2 cm wide appeared in the snow in the east-west direction. Most of the inhabitants heard a weak underground rumble and felt sharp jolts lasting up to 10 seconds. In the mine, at a depth of 120 m, miners who were sitting down felt the swaying, and one of the miners who was walking along sensed a brief (1-2 seconds) shock from above; the timberwork creaked, small lumps of coal and rock crumbled and a change was noticed in the release of gas (report of eyewitness I. G. Sokov). The intensity of the earthquake in the mine may be estimated as 4.5-5 points.

The city of Shakhtersk. In large-panel four-five-story houses, cracks formed between the blocks on the cornice slabs and the stories, and damage was noted in 30 brick chimneys; in some houses the water supply line was broken and the plaster (primarily whitewash) crumbled over an area of 2500 square meters; in the central boiler room the casing on three boilers burst. There were cases of damage to the heat line and the main pipeline. On the fourth and fifth floors in some houses the furniture shifted. In cinder block and wooden structures in places the plaster crumbled (mainly old) and fine cracks appeared in the walls and ceilings; in one of the wooden houses a corner of the oven heater collapsed and in another the oven broke away by 0.5 cm; some ovens were cracked. Cases are known of doors warping, damage to window panes, pendulum clocks stopping and water splashing out of vessels that were not full. Most of the inhabitants heard an underground rumble. In the mine here and there the roofing settled negligibly and the fluctuation in the gas content was within the limits of the usual deviations.

The Uglegorsk earthquake was felt somewhat more weakly, with an intensity approximately up to 6 points, in the settlement of Nadezhdino. This settlement is located on the shore of the Tatarskiy Strait and the houses are primarily one-story wooden ones. Eyewitness A. V. Basashar notes that at first he heard the bridge begin to creak (located closest to the strait). In the house a sizeable vertical crack formed from the floor to the ceiling and the oven cracked slightly; the bed shook approximately in the direction along the shore of the strait. In other houses doors opened wide, walls creaked, objects fell and in places, the plaster cracked; in frame-fill houses the heater for the oven cracked.

The earthquake was felt with an intensity of 5-6 points in the settlements of Tel'novskiy (a weak underground rumble was heard; hairline cracks in the plaster were formed in the walls and ceilings of some wooden houses in places; refrigerators shifted and in some cases glass jars fell from the shelves), Ol'khovka (in cinder block houses small lumps of lime crumbled and fine cracks appeared in the plaster; dish cupboards, television sets and latticework rocked; in one of the houses a picture fell from the wall and in another a television set fell from its stand) and a lumber camp section 15 kilometers east of Shakhtersk. In Lesogorsk the underground jolt in February was felt with an intensity of 5 points, and in the settlements of Izyl'met'yevo and Porech'ye--with an intensity of 4-5 points.

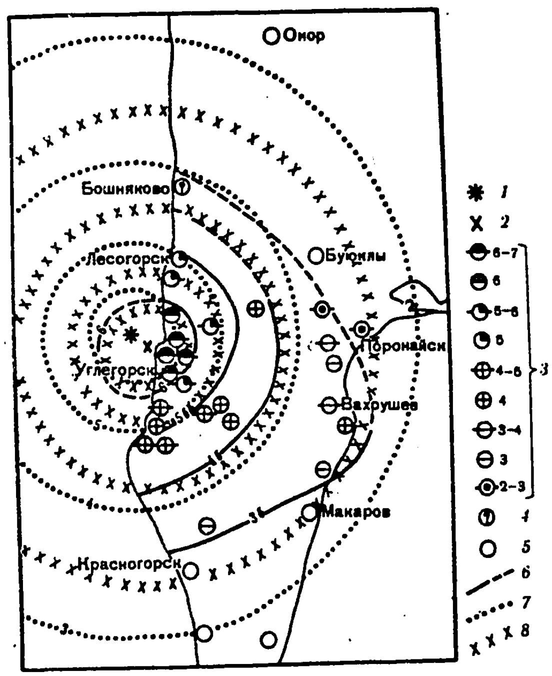

Figure 4. Diagram of the Surface Effect of the Uglegorsk Earthquake on 6 February

1--instrument epicenter; 2--epicenter according to macroseismic data; 3--intensity; 4--no information on the perceptibility; 5--not felt; 6--isoseismal lines observed, certain, and assumed; 7--theoretical circular isoseismal lines, plotted for the instrument epicenter, depth of focus 15 km and intensity at epicenter 6.7 points; 8--the same, for macroseismic epicenter, depth of focus 10 km and intensity at epicenter 7 points.

The earthquake on 6 February was felt with an intensity of 3-4 and 3 points in the settlements of Aynskoye, Tikhmenevo, Vakhrushev, Tumanovo, and Gastello. The eastern boundary of perceptibility passes through the city of Poronaysk.

In accordance with the macroseismic data processed, a diagram of the isoseismal lines observed was plotted, which is given in Figure 4. From this diagram were taken the maximum (r_{max}) and minimum (r_{min}) radii of the isoseismal lines observed. Then, from the formula $\bar{r} = \sqrt{r_{max} r_{min}}$ the average ($\bar{r}$) radii of the isoseismal lines were calculated: $\bar{r}_6 = 17$ km, $\bar{r}_5 = 32$ km, $\bar{r}_4 = 49$ km, $\bar{r}_3 = 73$ km. The values of $\bar{r}$ that were obtained were used to determine the intensity at the epicenter, magnitude and depth of the focus, and in this case the following values of the coefficients were used: b=1.6, S=4.3, c=3.3 (for greater detail see above).

The intensity at the epicenter according to the formula from work [3]

$$I_0 = bM - S \lg h + c$$

for instrument values M=4.7 and h=15 km was obtained as equal to I_{0n} =6.7 points. According to the table from [3] for the macroseismic data the intensity at the epicenter is equal to I_{0M} =7 points.

The average depth of the focus, calculated according to the formula

$$I_{0n} - I_i = S \lg \sqrt{\bar{r}_i^2 / h^2 + 1},$$

proved to be equal to h_1 = 14 km, and for I_{0M} h_2 = 11 km. Therefore, h = (15±5) km can be taken definitively for the depth of the focus of the Uglegorsk earthquake according to the instrument and macroseismic data.

The magnitude according to the macroseismic data was calculated according to the formulas:

$$M_1 = 1/b\,(I_i + S \lg \bar{r}_i - c), \quad M_2 = 1/b\,(I_{0M} + S \lg h_2 - c)$$

and is equal respectively to 4.8 and 5.0. These values negligibly exceed the instrument magnitude M_i = 4.7.

For the Uglegorsk earthquake, using N. V. Shabalin's methodology [3], the theoretical circular isoseismal lines were plotted, which are given in Figure 4. According to the formula

$$I_0 - I_i = S \lg \sqrt{1 + \Delta_i^2 / h^2}$$

Δ_i were calculated for two cases: 1) I_{0M} = 7 points and h = 10 km; 2) I_{0n} = 6.7 points and h = 15 km. Δ_i thus obtained (in km) are equal respectively to: 1) Δ_6 = 14, Δ_5 = 27, Δ_4 = 49, Δ_3 = 85; 2) Δ_6 = 16, Δ_5 = 34, Δ_4 = 62, Δ_3 = 108 km. In the first case the theoretical isoseismal lines were plotted in the form of concentric circles with the center at the macroseismic epicenter, and in the second--with the center at the epicentral epicenter. The theoretical isoseismal lines plotted with the center in the macroseismic epicenter are the closest to the observed ones.

During 1972 (see figs. 2 and 3 from work [1]) in the Uglegorsk region underground jolts occurred which may apparently be included among the number of foreshocks of the earthquake on 6 February 1973. Three of them had an energy class of K=9-10, two--K=8-9 and several--K=6-8. All of these preliminary underground jolts may be broken down into two groups: the epicenters of some were located west of the epicenter of the Uglegorsk earthquake, and of others--east of it, on the Sakhalin coast. In the region of the epicenter of the actual earthquake on 6 February, no preliminary underground jolts were recorded either in 1972 or in 1973; the last foreshock, with K=7, was registered on 20 January 1973. The Uglegorsk earthquake was accompanied by repeated jolts of varying energy level, some of which were felt by people in the nearby population centers (see catalog). The aftershocks surround the epicenter of the main jolt on all sides, but only some of the repeat jolts were registered directly at the epicenter.

Catalog of Earthquakes in Sakhalin in 1973 With K$\geqslant$8

Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	Класс точности	M	K	№ района	Макросейсмические данные
		φ°N	λ°E						
1	2	3	4	5	6	7	8	9	10

Key:

1. Date
2. Moment of origin, hrs, mins, secs
3. Coordinates of epicenter: φ°N
4. Coordinates of epicenter: λ°E
5. Focal depth, in km
6. Accuracy class
7. M
8. K
9. Number of region
10. Macroseismic data

				January					
7	13 26 36	46,4	140,9	10–20	A		9	8	
				February					
6	20 46 50	49,2	141,9	10–20	A	4,5		4	See text
	23 11 01	49,2	141,7	10–20	A		8	4	
7	02 36 41	49,1	141,8	10–20	A		8,5	4	
	08 51 32	49,1	142,4	10	A		8	4	
8	01 03 34	49,2	141,7	10–20	A		9,5	4	
9	05 06 47	49,1	141,9	10	A		8,5	4	
	14 11 02	49,2	141,8	10	A		8,5	4	
11	03 25 28	49,6	141,9	10–20	A		8	4	
	08 10 35	49,6	142,0	20	Б		8	4	
17	17 50 54	49,2	141,8	10	A		9,5	4	
18	03 56 56	49,1	141,9	5–10	A		8	4	
	07 46 16	49,1	141,8	10–20	A		8	4	
19	15 37 40	50,4	143,5	20–30	A		8,5	3	
20	12 40 53	49,2	141,8	0–10	A		8,5	4	
26	13 16 57	52,0	140,4	10–20	A		8	6	

1	2	3	4	5	6	7	8	9	10
				March					
16	21 33 40	46,8	142,2	10–20	А	3,5	8	4	
				April					
6	19 50 44	51,8	143,9	10–20	А		8	2	
7	12 32 30	51,8	143,8	10	А		8,5	2	
25	02 10 35	52,0	140,7	20–30	Б		8	7	
	02 22 22	50,5	141,8	10–20	А		8,5	4	
				May					
10	11 14 48	51,7	144,2	10	Б		8	2	
17	15 31 54	46,2	141,6	10–20	Б		8	4	
23	07 03 26	46,9	142,9	10	А		8	6	
				June					
4	15 34 38	46,7	140,9	10–20	А	4,5	10	8	Холмск, 3–4 балла; о-в Монерон, 4 балла
17	01 02 40	54,3	140,5	20–30	Б		8,5	7	
				July					
7	04 07 11	52,6	144,0	20–30	А	4		2	
11	16 17 58	49,3	141,9	10–20	А		8,5	4	
				August					
2	00 24 38	46,3	141,2	20–30	А	4,5		4	о-в Монерон, 3–4 балла
				September					
9	20 21 54	49,9	141,7	10–20	А		8	4	
				October					
3	16 27 30	46,2	141,4	10	Б		8	4	
12	23 52 40	46,3	141,6	5–10	А		8	4	
13	07 59 36	48,9	141,8	10	А		8	4	
22	14 05 01	49,1	141,9	20	А		8	4	
28	08 25 01	51,2	142,3	10–20	А		8	4	
				November					
3	18 03 34	54,4	141,7	20	Б		8	1	
4	13 01 42	53,9	141,3	20–30	Б	4,7		1	
6	08 13 58	52,7	143,9	20–30	Б		8	2	
7	00 36 34	54,3	141,8	10–20	Б		8	1	
	20 08 16	53,7	141,8	20	Б		8	1	
17	13 17 50	50,2	141,8	20–30	Б		8,5	4	

1	2	3	4	5	6	7	8	9	10
				December					
1	08 42 20	46,5	143,4	10	Б		8	6	
3	10 19 51	49,2	141,6	20–30	А		9	8	Углегорск, 3 балла
9	11 53 52	53,8	141,5	20	Б		8,5	1	
22	20 13 04	46,1	141,3	5–10	Б		8,5	4	

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EARTHQUAKES IN THE KURIL ISLANDS AND THE SEA OF OKHOTSK

L. N. Poplavskaya, A. N. Boychuk, M. I. Rudik

In 1973 the Kuril-Okhotsk epicentral zone was characterized by an exceedingly high level of seismic activity. During the first half of the year four earthquakes with $M \geqslant 7$ occurred here: on 28 February at 06:37, on 17 June at 03:55, on 24 June at 02:43 and on 26 June at 22:32 (Greenwich time). These earthquakes were accompanied by a considerable macroseismic effect and in turn provoked the appearance of highly active focal zones in the northern and southern regions of the Kuril Island Arc (Fig 1).

The Catalog of Earthquakes in 1973, inserted at the end of this article, contains information on 1,144 seismic jolts with $M \geqslant 4$ (K=9). It does not include information on 558 jolts with $4 \leqslant M \leqslant 4.25$, registered in the period from 17 to 30 June in the focal zone of the earthquakes on 17, 24 and 26 June 1973, the coordinates of the epicenters for which were not determined. In evaluating the quantitative characteristics of the seismic conditions, however, these earthquakes were taken into consideration.

The aggregate of earthquakes in 1973 retained the relation, characteristic for the region, of the number of hypocenters to the depth of their occurrence. In general form this relation may be described as a function of the type

$$\Sigma N_i = A h_i^a, \qquad (1)$$

where ΣN_i is the number of jolts in the stratum of the given thickness, h_i is the value of the depth of the lower limit of the i layer, and A and a are the parameters. Since the accuracy of determining the depth of the focus in the Kuril-Okhotsk region is apparently within a range of ± 10 km, we will assume $h_{i+1} - h_i$ = 10 km. Then, in accordance with (1), we obtain the following values for the parameters of A and a:

for $h = 0 \div 40$ км $A = -0,71$, $a = 2,07$;
for $h > 40$ км $A = 7,59$, $a = -3,27$.

Therefore, close to a depth of 40 kilometers, parameters A and a undergo a change of signs, which indicates the presence of an extremum of the function (1). In reality, an analysis of Table 1 shows that at depths of

20-40 km, corresponding to the depths of occurrence of the boundaries of Mokhorovichicha in the Far East, the maximal number of hypocenters of the earthquakes of 1973 are located.

Table 1. Distribution of the Number N of Kuril-Okhotsk Earthquakes by Depth H (km) of Ocurrence of the Hypocenters

H, км	N	H, км	N	H, км	N	H, км	N
0–10	30	151–160	1	301–310	1	451–460	1
11–20	55	161–170	1	311–320	1	461–470	1
21–30	218	171–180	2	321–330	4	471–480	2
31–40	529	181–190	2	331–340	1	481–490	1
41–50	115	191–200	2	341–350	4	491–500	4
51–60	55	201–210	1	351–360	1	501–510	1
61–70	32	211–220	–	361–370	–	511–520	–
71–80	8	221–230	2	371–380	2	521–530	–
81–90	10	231–240	1	381–390	1	531–540	–
91–100	10	241–250	3	391–400	3	541–550	–
101–110	6	251–260	–	401–410	–	551–560	–
111–120	5	261–270	–	411–420	1	561–570	–
121–130	7	271–280	–	421–430	–	571–580	–
131–140	5	281–290	1	431–440	–	581–590	1
141–150	6	291–300	3	441–450	2	591–600	2

Against the background of this basic conformance to principle in the southern and northern regions of the Kuril epicentral zone are noted, as we can see below, shifts in the maximum of function (1): for Northern Kuril the maximum number of earthquakes with M=5 was observed at depths of 50-60 kilometers, and in the southern regions of the island arc, two maximums were noted--at depths of 20 and 50 kilometers.

The frequency graph of the Kuril-Okhotsk earthquakes in 1973 with a focal depth of h = 0-80 km, is calculated according to the data in Table 2, taking into consideration the above-mentioned aftershocks from 17-30 June, has the form

$$\lg N = 7{,}02 - 1{,}05\,M\,(\pm 0{,}26), \qquad (2)$$

where N is the number of earthquakes with a given magnitude M, and M varied from 4.5 to 6.5 with a spacing of M=0.25. From (2) it follows that in 1973 in the Kuril-Okhotsk region apparently not more than 6 percent of the earthquakes with M=4 (K=9) were omitted. An analysis of Table 2 reveals an anomalous number of earthquakes of this energy level in the Paramushir region.

In 1973 information was obtained on the macroseismic manifestations of 80 Kuril-Okhotsk earthquakes. Table 3 gives their distribution by individual seismoactive regions.

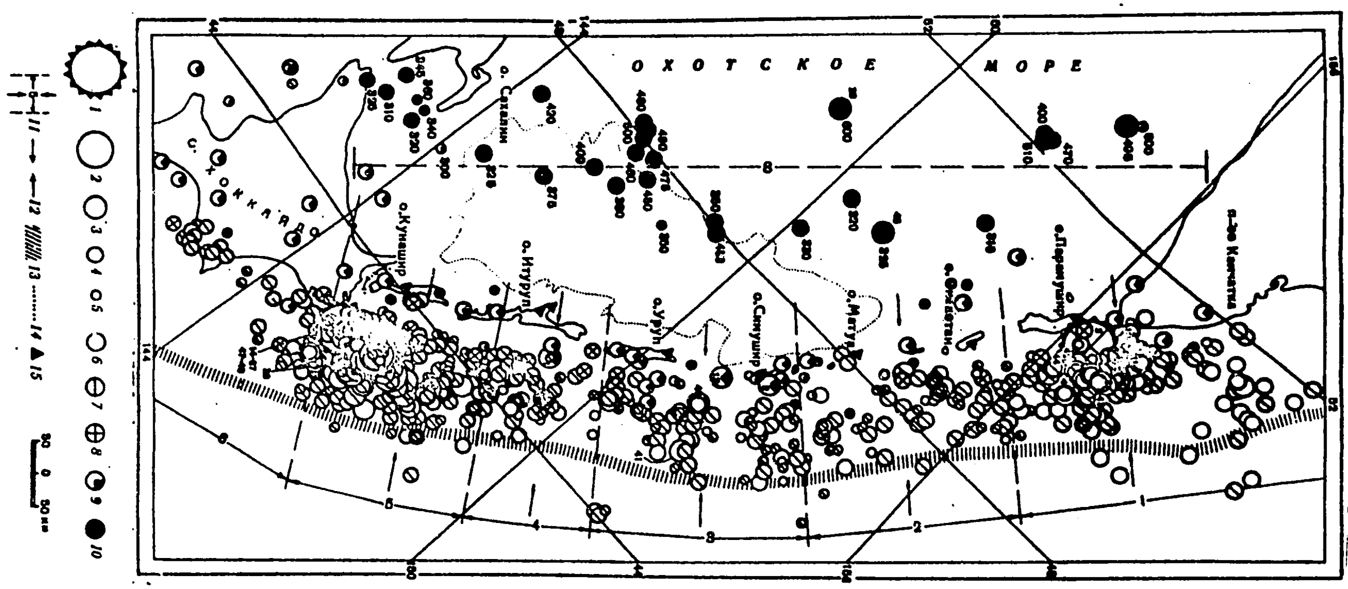


Figure 1. Map of Epicenters of Kuril-Okhotsk Earthquakes With $K \geqslant 9$ ($M \geqslant 4$)

Magnitude and energy class: 1--$7.5 \leqslant M$; 2--$6.5 \leqslant M < 7.5$; 3--$5.25 \leqslant M < 6.5$; $11 < K < 14$; 4--$4.25 \leqslant M \leqslant 5.25$, $9 < K < 11$; 5--K=9. Focal depth: 6--$0 < H \leqslant 30$ km; 7--$30 < H \leqslant 60$ km; 8--$60 < H \leqslant 90$ km; 9--$90 < H \leqslant 300$ km; 11--boundaries of seismoactive regions of Kuril Islands; 12--position of axial part of depth sections; 13--axis of deep-water Kuril-Kamchatka channel; 14--outline of deep-water Southern Okhotsk trough; 15--seismological stations

Table 2. Distribution of the Number N of Kuril-Okhotsk Earthquakes With Focal Depth h = 0-80 km by Regions, Depending on Magnitude M (or Energy Class K)

M (K)	(2) Номер района								Всего (3)
	1	2	3	4	5	6	7	8	
4 (9)	50	32	38	23	116	14	1	–	274
4,25 (9,5)	108	15	21	7	98	10	1	2	262
4,5 (10)	85	14	19	12	129	22	–	–	281
4,75 (10,5)	29	3	2	6	45	6	–	–	91
5 (11)	22	1	4	2	43	4	–	–	76
5,25 (11,5)	8	–	2	1	13	–	–	–	24
5,5 (12)	2	1	–	–	7	1	–	–	11
5,75 (12,5)	2	–	–	–	4	–	–	–	6
6 (13)	3	–	–	–	4	1	–	–	8
6,25	1	–	–	–	–	–	–	–	1
6,5	–	–	–	–	4	–	–	–	4
6,9	–	–	–	–	1	–	–	–	1
7,25	–	–	–	–	–	–	–	–	–
7,5	1	–	–	–	1	–	–	–	2
7,75	–	–	–	–	–	–	–	–	–
7,9	–	–	–	–	1	–	–	–	1
(3) Всего	311	66	86	51	466	58	2	2	1042

Key:
1. Number of Region
2. Total

Table 3. Distribution of Number N of Perceptible Earthquakes by Individual Seismoactive regions

№ (1) района	Общее число землетрясений по каталогу (2)	(3) Число ощутимых толчков	(4) Максимальный балл
1	317	50	7
2	79	2	6–7
3	97	4	3–4
4	54	2	5
5	482	21	7–8
6	66	1	1–2
7	11	–	–
8	38	–	–

Key:
1. Number of region
2. Total number of earthquakes according to catalog
3. Number of jolts felt
4. Maximum point

The greatest shock was experienced in the coastal region of the Lesser Kuril Range and Shumshu and Paramushir islands, where the macroseismic effect reached 8 points.

An analysis of the seismicity, just as in the preceding years [2], was made according to the eight seismoactive regions into which the Kuril-Okhotsk region was divided.

Earthquakes in the Kuril Islands

The spatial-temporal distribution of seismic jolts in the Kuril epicentral zone may be traced by analyzing the map of epicenters (Fig. 1), the map of the density of epicenters of the earthquakes (Fig. 2), brought to a single level with the aid of the frequency graph, the projection of the focal points of the earthquakes to the vertical planes, parallel and perpendicular to the strike of the island arc (figs. 3, 4) and also Fig. 5, which characterizes the temporal course of the seismic process in regions 1-5 of the Kuril epicentral zone.

The Paramushir region. The main event that determined the seismic life of the region was the earthquake on 28 February at 06:37 Greenwich time with a magnitude of M=7.5, with its focus located near Paramushir and Shumshu islands at a depth of H=70 km. The earthquake caused a considerable macroseismic effect and caused tsunami to appear. A separate article is devoted to a detailed study of the conditions of the focal zone of this earthquake and the phenomena accompanying it.

From the moment of occurrence of this earthquake and until the end of the year, high seismic activity (figs. 1, 2) was observed in the Paramushir region. The seismic jolts in the time following occurred uniformly frequently, but their energy level in the first half of the year was higher than in the second half. This circumstance was reflected in the frequency graph of earthquakes with H=0-8 km for the Paramushir region. In the period of observations from 1 January to 31 December 1973, the frequency graph, calculated according to the data from Table 2, takes the form

$$\lg N = 6{,}52 - 1{,}06\,M\ (\pm 0{,}20), \tag{3}$$

where N is the number of seismic jolts of a given magnitude M, which varied from 4.5 to 6 with a spacing M=0.25. In the period from January to June (a) and July-December (b) 1973, the parameters of the function (3) proved to be as follows:

$$\begin{aligned} \lg N &= 5{,}08 - 0{,}84\,M\ (\pm 0{,}31), \\ \lg N &= 7{,}14 - 1{,}30\,M\ (\pm 0{,}08), \end{aligned} \tag{4}$$

in this case the intervals of change in M and ΔM correspond to (3).

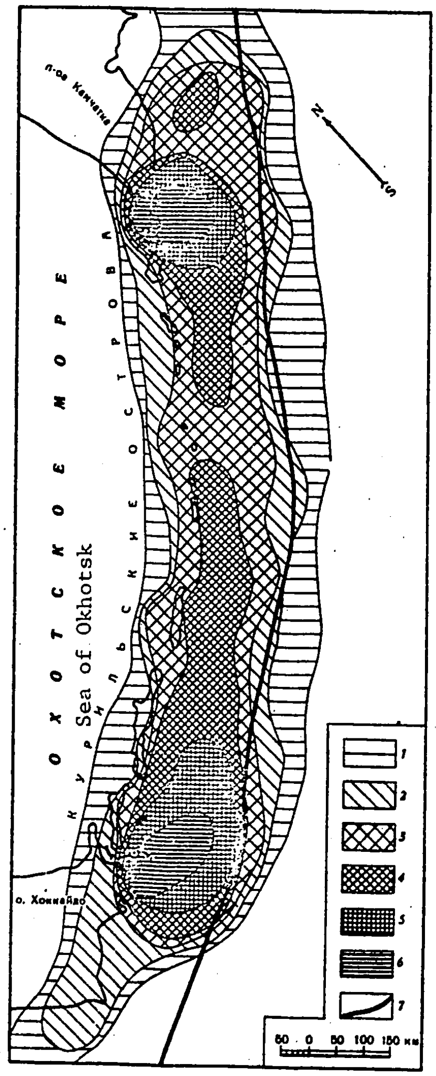


Figure 2. Map of the Density of Kuril Earthquakes, Brought to the Level M=4 With the Aid of a Frequency Graph

1--$\Pi_{M=4} \leq 1$; 2--$1.1 \leq \Pi_{M=4} \leq 3$; 3--$3.1 \leq \Pi_{M=4} \leq 9$; 4--$9.1 \leq \Pi_{M=4} \leq 27$; 5--$27.1 \leq {}_{M=4} \leq 81$; 6--$81.1 \leq \Pi_{M=4}$; 7--axis of deep-water trough

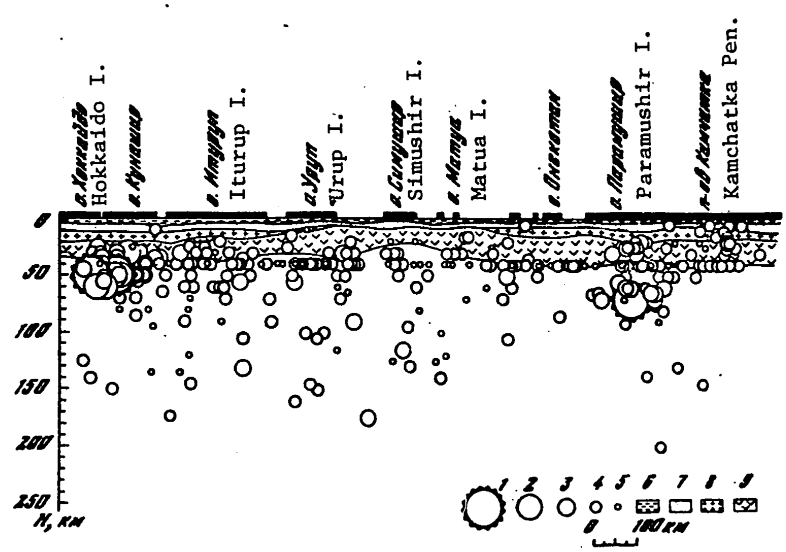


Figure 3. Projection of Hypocenters of Kuril Earthquakes on Vertical Plane, Passing Along the Kuril-Kamchatka Arc 130 km From the Coast

1-5--correspond to the designations in Fig. 1; 6--water; 7--sediments (average rate of P-waves less than 3.5 km/sec); 8--"granite" stratum (rate of P-waves 5.2-6.4 km/sec); 9--"basalt" stratum (rate of P-waves 6.4-7.0 km/sec); boundaries 7-9 are given according to work [2].

An analysis shows that in the second half of the year the number of seismic jolts with low energy exceeds the number of such jolts registered in January-June. Since in 1973 the network of observing stations, as well as the parameters of the recording equipment at them did not change, it should be assumed that, apparently, the seismic events of 17-26 June in the southern regions of the Kuril Island arc affected the development of the seismic process in the Paramushir region in the course of the second half of the year. A similar effect, as we will see below, is detected upon analyzing Figure 5 for the entire aggregate of seismoactive regions of the Kuril Islands.

The strongest repeated jolts of the earthquake on 28 February occurred at depths of 60-70 km (figs. 3 and 4, No 1) and were accompanied by macroseismic phenomena, the intensity of which reached 6 points. In the course of the year information was obtained on the macroseismic manifestation of a total of 50 Paramushir earthquakes.

The main mass of earthquakes in the Paramushir region with a normal focal depth was located between the island arc and the deep-water trough, and only two weak (K=9.5) jolts were observed beyond the basin.

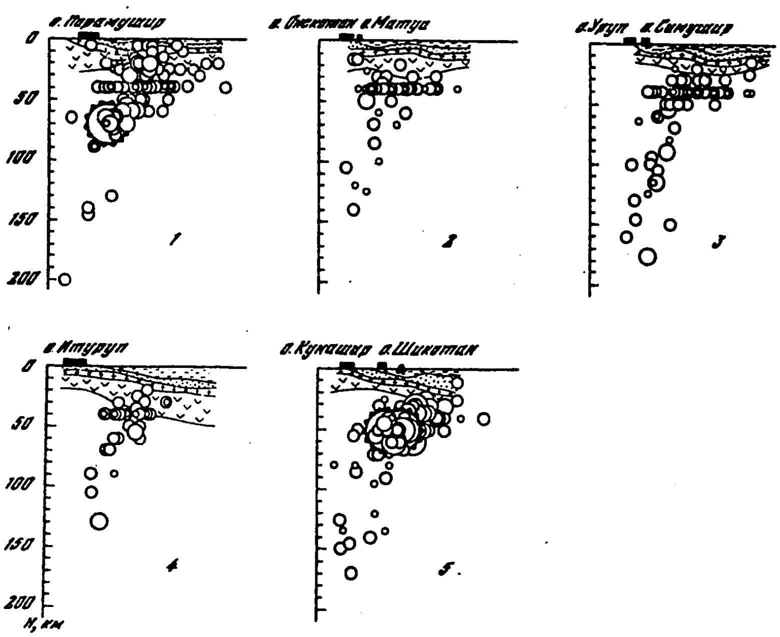


Figure 4. Transverse Vertical Projections of Focal Points of Kuril Earthquakes for Regions 1-5, Singled Out in Figure 1

For designations see Fig. 3.

The deep-focus earthquakes constituted only 2.5 percent of the total number of earthquakes in the Paramushir region (Table 4), and their magnitude m_{PV} did not exceed 4.5. These jolts gravitate toward the shelf zone of the islands of Paramushir and Shumshu, as well as the coastal region of Southern Kamchatka, where the deepest of them was observed (figs. 3, 4, No 1).

Onekotan-Matua region. In 1973 this region, which in 1972 had been the most active in the Kuril epicentral zone, was characterized by low seismic activity (figs. 1, 2). The strongest earthquake, with M=5.4, was recorded on 17 December at 21:54, 80 kilometers east of Matua Island at a depth of H=50 km. The macroseismic effect of the earthquake on 17 December reached Matua Island with an intensity of 6 points, but no information was received on its manifestation on other islands. An analysis of the mechanism of the focus of this earthquake (Table 5) shows that its hypocentral area was under the influence of nearly horizontal compression stresses, and both possible fault planes were steep and directed transverse to the strike of the island structures.

Table 4. Distribution of Deep-Focus Earthquakes (H > 80 km) by Regions, Depending on Magnitude m_{PV}

m_{PV}	(1) Номер района								(2) Итого
	1	2	3	4	5	6	7	8	
4	1	3	2	1	10	3	3	6	29
4,25	1	2	2	1	4	1	1	8	20
4,5	6	1	3	–	2	4	2	13	31
4,75	–	–	–	–	–	–	–	3	3
5	–	2	1	–	–	1	1	2	7
5,25	–	–	2	–	–	–	–	1	3
5,5	–	–	2	1	–	–	–	2	5
5,75	–	–	1	–	–	–	–	–	1
6	–	–	–	–	–	–	–	1	1
6,25	–	–	–	–	–	–	1	–	1
6,5	–	–	–	–	–	–	–	–	–
6,75	–	–	–	–	–	–	1	–	–
(2) Всего	8	8	13	3	16	9	9	36	101

Key:

1. Number of region
2. Total

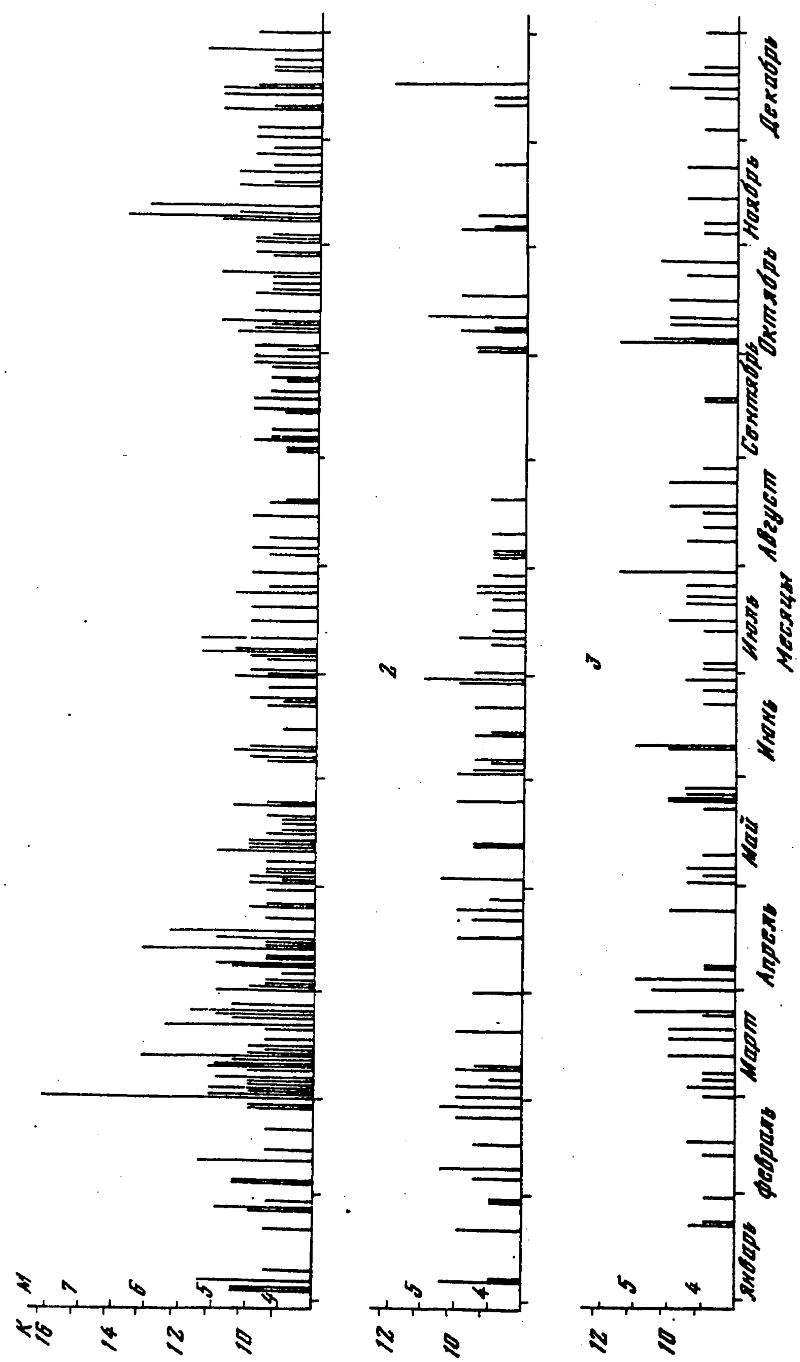
The earthquakes with a normal focal depth (H=0-80) were quite uniformly distributed between the shelf and the deep-sea basin (figs 1, 3 and 4, No 2). Two jolts with M=5 near Matua Island were recorded on 29 June at 03:13 and 05:32 at a depth of h =15 km. Such jolts are not a rarity in the Matua Island region and, apparently, are connected with one of the ocal manifestations of regional seismic activity. One of the jolts was felt by the population of Matua Island, with its effect reaching 5-6 points.

Deep-focus earthquakes constituted 9.5 percent of the total number of seismic events in the Onekotan-Matua region (see Table 4).

Strike-slip normal fault dislocations (see Table 5) with a predominance of the fault component of the push are characteristic of the focal points of earthquakes recorded in the region of Shiashkotan and Ketoy islands. The main compression and tension stresses in them run transverse to the strike of the island structures, and the interstitial stress--along them.

The level of seismic activity in the Onekotan-Matua region was low during 1973: the magnitude of the strongest of the shallow-focus earthquakes was M=5.4, and the strongest of the deep-focus was m_{PV}=5. Against this background of weak seismic activity too, however, its reduction in the second half of the year was noticeably sharp.

Simushir-Urup region. Just as in the Onekotan-Matua region, this region was quiescent in the seismic respect. The magnitude of earthquakes with H=0-80 km did not exceed M=5.25, and of the deeper ones--m_{PV}=5.75. Here, just as in the adjacent region, a reduction in activity is observed in the second half of the year, but is not so sharply marked (see Fig. 5).


K
M
16
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4
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Январь
Февраль
Март
Апрель
Май
Июнь
Июль
Август
Сентябрь
Октябрь
Ноябрь
Декабрь
Месяцы

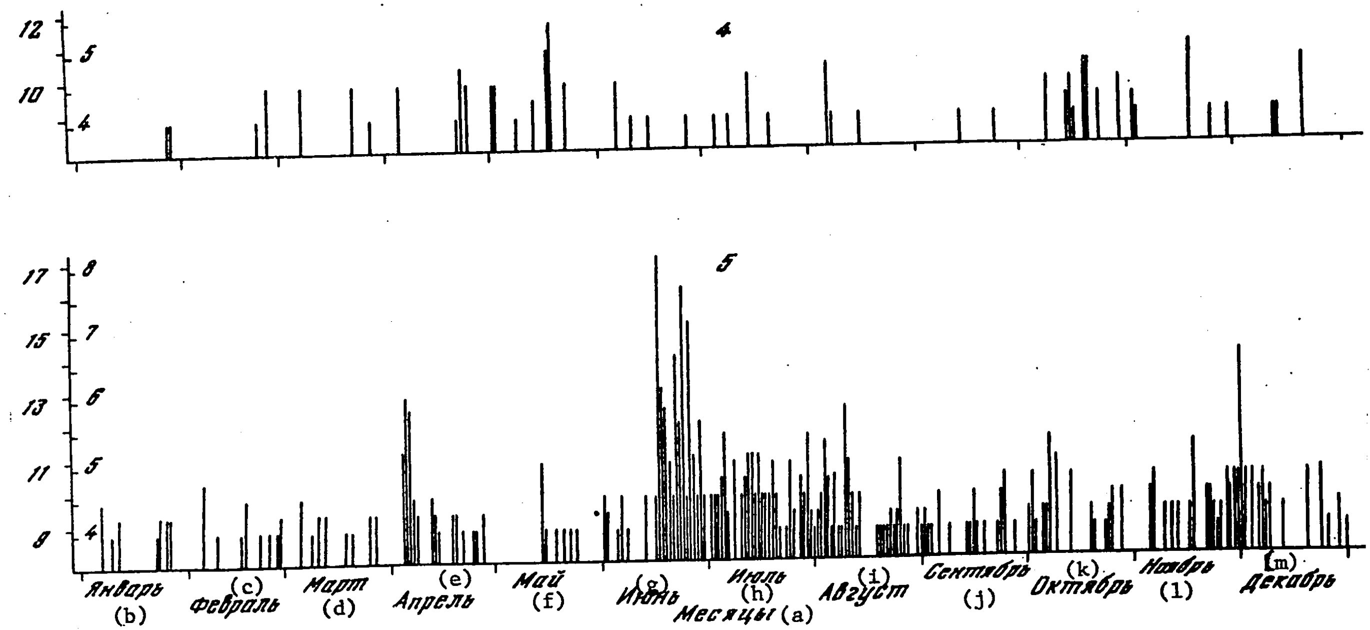

Figure 5. Graphs of the Time Dependence of the Seismic Process for Regions 1-5, Singled Out in Figure 1.

a--months; b--January; c--February; d--March; e--April; f--May; g--June; h--July; i--August; j--September; k--October; l--November; m--December

Table 5. Mechanism of Earthquake Focuses in Kuril Epicentral Zone

Дата (1973 г.) (1)	Время возникновения, час, мин, сек (2)	(3) Координаты гипоцентра φ°N	λ°E	H, км	m_{PV}	№ района	(4) Плоскость I A_z°	e°	Компоненты подвижки (5) по простиранию (6)	по падению (7)
17.II	19 15 14	44,9	148,9	130	5,4	4	163	80	0,829	+0,559
21.III	21 46 13	48,7	153,7	105	4,9	2	157	70	0,857	−0,515
25.III	13 34 59	45,8	151,4	70	5,0	3	63	58	0,669	+0,743
3.IV	10 59 29	45,7	151,4	50	4,5	3	323	64	0,777	+0,629
8.IV	21 55 01	47,2	152,2	100–120	5,7	3	337	82	0,719	−0,695
1.V	00 52 39	44,0	148,6	25	4,5	4	263	60	0,754	+0,656
8.V	07 49 02	45,4	149,9	100	5,2	3	210	68	0,743	−0,669
14.V	02 19 02	44,1	148,3	60	5,5	5	158	80	0,866	+0,500
17.V	06 17 51	44,7	149,4	50	5,5	4	125	76	0,966	+0,258
18.V	10 36 52	44,5	149,4	50	5,3	4	144	50	1,00	+0,00
21.V	09 16 47	47,6	152,5	140	4,9	2	304	70	0,829	−0,559
9.VI	03 43 06	44,0	151,8	10–20	5,0	3	96	72	0,743	−0,669
13.VI	00 20 52	46,9	151,1	175	5,5	3	320	71	0,913	−0,406
8.VII	23 35 33	45,1	148,1	105–110	5,0	4	98	66	0,848	−0,529
29.VII	09 11 05	45,2	150,3	55	5,1	3	72	70	0,898	+0,438
12.IX	20 12 25	45,6	149,5	160	5,0	3	07	60	0,788	+0,615
3.X	10 35 51	45,4	152,0	30	5,4	3	66	68	0,874	−0,485
19.X	23 40 10	44,2	149,1	60	4,7	4	262	60	0,669	+0,743
20.X	00 24 36	44,2	149,1	30	4,5	4	103	70	0,891	+0,454
18.XI	12 07 37	44,3	149,1	50	4,7	4	199	50	0,529	−0,848
21.XI	21 05 23	46,1	151,6	90	5,6	3	311	78	0,866	−0,500
17.XII	21 54 07	48,1	154,7	50	5,4	2	258	66	0,829	+0,559

(8) *Окончание*

(1) Дата (1973 г.)	(9) Плоскость II A_z°	e°	(3) Компоненты подвижки по простиранию (6)	по падению (7)	(10) Напряжение: сжатия (11) A_z°	e°	промежуточное (12) A_z°	e°	растяжения (13) A_z°	e°
17.II	260	58	0,978	+0,208	124	13	237	55	26	29
21.III	260	60	0,921	−0,391	26	35	218	53	119	04
25.III	302	49	0,755	+0,656	90	04	356	33	188	54
3.IV	164	54	0,829	+0,559	290	06	25	42	196	46
8.IV	77	46	0,982	−0,191	196	36	59	44	305	23
1.V	16	55	0,788	+0,615	230	04	323	40	135	50
8.V	317	52	0,891	−0,454	80	43	277	44	178	09
14.V	253	60	0,981	+0,191	119	12	233	58	21	28
17.V	219	70	0,984	+0,174	83	02	176	64	350	19
18.V	329	42	1,00	+0,00	144	05	53	00	319	85
21.V	50	56	0,898	−0,438	172	39	10	48	269	07
9.VI	347	50	0,906	−0,422	230	43	23	44	128	14
13.VI	58	66	0,766	−0,642	189	45	13	58	90	06
8.VII	356	60	0,898	−0,438	228	40	41	49	136	04
29.VII	333	66	0,933	+0,358	112	04	18	58	204	31
12.IX	256	58	0,809	+0,587	40	02	309	43	131	48
3.X	326	64	0,920	−0,390	197	36	11	54	105	03
19.X	20	59	0,766	+0,642	232	06	327	35	133	54
20.X	04	66	0,951	+0,309	143	05	47	58	235	31
18.XI	334	48	0,544	−0,838	184	66	267	23	177	00
21.XI	214	60	0,978	−0,207	85	28	239	57	348	12
17.XII	04	58	0,866	+0,500	222	04	317	48	129	40

[Key on following page]

Key to Table 5:

1. Date
2. Time of occurrence, hrs, mins, secs.
3. Coordinates of hypocenter
4. Plane I
5. Shift components
6. Along the strike
7. Along the dip
8. Conclusion
9. Plane II
10. Stress
11. Compression
12. Interstitial
13. Tension

The number of deep-focus jolts (Table 4) occurring in a depth range of H=90-175 km (figs 3 and 4, No 3) was relatively great (about 13%). The strongest of the deep-focus jolts with m_{PV}=6.3 was recorded on 8 April at 21:55 in the Simushir Island region at a depth of H=110 km. The dynamic parameters of the focal mechanism of this earthquake are given in Table 5. Strike-slip normal fault shifts were noted along both possible fault planes with the axis of main tension stress close to horizontal and directed at a right angle to the island structures. The axes of compression and interstitial stress ran parallel to the strike of the Kuril Island arc. An analogous focal mechanism was observed (Table 5) as well for the earthquake on 13 June at 00:21, recorded 50 kilometers south of Simushir Island at a depth of 175 kilometers.

The dynamic parameters were also determined for the focal points for two deep-focus jolts registered near the southern end of Urup Island: on 12 September at 20:12 and on 8 May at 07:49. At the focus of the earthquake on 12 September (H=160 km) the strike-slip thrust fault nature of the movement was noted along both possible fault planes, with the uplifts being characteristic for the continental limbs, which moved, relative to the oceanic limbs, in the direction of the Asian continent.

At the focus of the earthquake on 8 May (H=100 km), the sign of the shift was the opposite: along both possible nodal planes a strike-slip normal fault was noted, since the focus was located under the conditions of tension stresses close to horizontal.

Northern Iturup region. In 1973 the region of the Kuril seismoactive zone was the most quiescent. During the year 54 earthquakes were recorded here, with the magnitude of the jolts with H=0-80 km not exceeding M=5.25, and of the deeper ones, m_{PV}=5.5. The principal number of Northern Iturup earthquakes were included in the southern part of this small region, adjacent to the Iturup-Kunashir region, most active in 1973 (see Fig. 1).

Table 6. Results of Determining the Focal Mechanisms of the Deep-Focus Earthquakes in the Seas of Okhotsk and Japan

(1) Дата (1973 г.)	(2) Время возникновения, час, мин, сек	Координаты гипоцентра (3)			m_{PV}	(4) № района	(5) Плоскость I			
									Компоненты подвижки (6)	
		φ°N	λ°E	H, км			A_z^o	e°	по простиранию (7)	по падению (8)
5.I	13 39 52	47,6	146,2	450	4,8	8	249	70	0,754	+0,656
15.I	01 53 13	45,6	143,1	345	5,1	8	210	68	0,719	+0,695
28.I	17 01 50	41,8	141,0	100	5,0	7	294	80	0,848	+0,529
6.V	14 39 30	43,4	132,4	500	5,5	8	257	78	0,743	+0,669
28.VII	20 06 36	49,9	140,6	600	6,0	8	120	70	0,866	−0,500
10.IX	07 43 31	42,0	130,7	585	6,4	7	279	74	0,292	+0,956
29.IX	00 44 02	42,0	131,0	600	6,7	7	282	80	0,104	+0,994
24.X	04 27 56	48,1	146,5	490	4,6	8	253	72	0,731	+0,682
24.X	11 28 35	48,0	146,6	500	4,6	8	316	60	0,809	+0,587
13.XI	02 47 16	49,6	151,5	325	5,5	8	246	62	0,173	+0,985
29.XI	17 59 20	53,2	153,5	490−500	5,2	8	44	50	0,292	−0,956

(9) *Окончание*

(1) Дата (1973 г.)	(10) Плоскость II				(11) Напряжение					
			Компоненты подвижки (6)		(12) сжатия		промежуточное (13)		растяжения (14)	
	A_z^o	e°	по простиранию (7)	по падению (8)	A_z^o	e°	A_z^o	e°	A_z^o	e°
5.I	140,5	50	0,898	+0,438	281	10	178	43	21	42
15.I	319	50	0,875	+0,485	179	11	279	42	77	46
28.I	196	60	0,974	+0,225	331	14	222	58	69	29
6.V	155	49	0,966	+0,258	291	19	178	47	35	36
28.VII	222	60	0,914	−0,406	349	36	179	52	350	36
10.IX	146	23	0,707	+0,707	292	28	194	16	76	58
29.IX	137	12	0,544	+0,798	283	36	194	06	103	56
24.X	146	48	0,906	+0,423	286	15	180	44	32	42
24.X	205	58	0,809	+0,587	351	01	260	45	80	46
13.XI	42	30	0,358	+0,933	239	16	331	10	92	70
29.XI	198	44	0,325	−0,945	284	76	123	12	31	05

Key:

1. Date
2. Time of occurrence, hrs, mins, secs.
3. Coordinates of hypocenter
4. Number of region
5. Plane I
6. Shift components
7. Along the strike
8. Along the dip
9. Completion
10. Plane II
11. Stress
12. Compression
13. Interstitial
14. Tension

Just as in the other, above-described seismoactive regions, in the Northern Iturup region the activity was higher during the second half of the year than during the first (Fig. 5, No 4).

Preliminary data on the dynamic parameters of the focal points of seven earthquakes in the Northern Iturup region are given in Table 5. Characteristic of them were strike-slip thrust fault shifts along the steep fault planes, directed along and across the strike of the Kuril arc. Strike-slip normal fault dislocations were recorded for only one of the deep-focus jolts, registered on 8 July at 23:35 (H=105-110 km).

Kunashir-Iturup region. In 1973 it was characterized by the most sizeable events in the entire Kuril-Okhotsk region: on 17, 24 and 26 June seismic jolts were recorded here in the region of the Lesser Kuril Range, with a magnitude of M=7.9; 7.6 and 6.9 respectively. Their focal depths were H=50 km. All three jolts were accompanied by a considerable macroseismic effect, which reached intensities of 7-8 points at the nearby islands, with the first two also producing tsunami. For details on the earthquakes on 17 and 24 June see the separate article in this collection.

The event of similar energy level in the Lesser Kuril Range region that was closest in time was observed on 11 August 1969 [1]. The earthquakes on 17-26 June 1973 occurred outside the area encompassed earlier by the focal zone of the earthquake in 1969. It was preceded, however, by a cluster of earthquakes on 4-8 April 1973, observed at the southeastern end of the hypocentral area of the Shikota earthquake in 1969.

Strike-slip normal fault dislocations were characteristic of the focal points on 4-8 April 1973, and the directions of the possible fault planes and axes of main stresses were analogous to those traced in [1].

In contrast to the Shikotan earthquakes in 1969, the earthquakes from 17-26 June 1973 occurred under conditions of compression maximally close to horizontal and were characterized primarily by strike-slip thrust dislocations.

Before the occurrence of the June events in the Iturup-Kunashir region, individual weak jolts were observed (Fig. 5, No 5), and the frequency graph for them took the form

$$\lg N=6.665-1.24\ M\ (\pm 0.26),$$

where N is the number of jolts of the given magnitude M, and M varied from 4.5 to 6 with a spacing of Δ M=0.25.

After the June events, the frequency graph of the Iturup-Kunashir earthquakes in 1973 with M=4.5-6 changed in the following way:

$$\lg N=7.08-1.14\ M\ (\pm 0.20).$$

On the whole, the frequency of the earthquakes in the Iturup-Kunashir region in 1973 with M=4.5-6 is described by the equation

$$\lg N = 6.79 - 1.06M \ (\pm 0.13).$$

The distribution of the Iturup-Kunashir earthquakes with H=0-80 km with respect to the depth of the focus had maximums at depths of H=50-60 and 30-40 km, to which the maximal magnitudes observed corresponded.

Deeper jolts with $H > 80$ km were recorded more frequently in this region than in other parts of the Kuril Island arc, but they did not exceed an energy level of $m_{PV}=4.5$ (Table 4). The hypocenter of the deepest of them was observed at a depth of H=170 km in the region of the southern end of Iturup Island.

As was mentioned earlier, the increased activity of the southern region of the Kuril epicentral zone was accompanied by some weakening of the seismic activity in other seismoactive regions. In turn, the events on 28 February 1973 in the Paramushir region apparently affected the development of the seismic process in the Iturup-Kunashir region.

The similarity of the parameters of the frequency graphs of the Paramushir and Iturup-Kunashir earthquakes in 1973 may serve as indirect confirmation of this mutual influence:

Region No 1 $a=6.52$, $b=1.06$;
Region No 5 $a=6.79$, $b=1.06$.

Let us remember that according to the observations in 1961-1971, the parameters of the frequency graphs of the earthquakes in the Paramushir and Iturup-Kunashir regions differed substantially [2]:

Region No 1 $a=7.9$, $b=1.2$;
Region No 5 $a=6.7$, $b=0.93$.

An analysis of Figure 5, Nos 1 and 5 makes it possible to establish that the effect of the Iturup-Kunashir seismic events on the activity of the Paramushir region was not instantaneous, and was manifested 1-1.5 months after the events of 17-26 June, since the sharp reduction in the energy level of the repeated jolts of the earthquake on 28 February was noted in the middle of July-August.

Deep-Focus Earthquakes of the Seas of Okhotsk and Japan

In 1973 in the Sea of Okhotsk earthquakes with $90 \leq H < 300$ km occurred very rarely and were concentrated mainly near the Okhotsk coastal region of the Paramushir and Onekotan islands. Their magnitude did not exceed the level of $m_{PV}=5.25$. Deeper ($H \geq 300$ km) Sea of Okhotsk earthquakes, the total number of which was N=34, were located in a narrow belt extending from the south of Sakhalin Island to the western coast of Kamchatka. South of

Sakhalin Island they formed a group of focal points in Aniva Bay. Another group is observed near the northwest boundary of the Southern Okhotsk trough. The strongest of the Sea of Okhotsk earthquakes was recorded in its central region at a depth of H=597 km and had a magnitude m_{PV}=6.1.

In determining the mechanism of the focus of deep (H > 90 km) earthquakes (Table 6) we used the same method as for the shallow-focus earthquakes. The presence of deep earthquakes in the mantle to a depth of 600-700 km is evidence that at these depths too, the release of accumulated stresses is possible.

All the deep-focus earthquakes for which the focal mechanism was determined we subdivided into groups.

The first group included deep earthquakes located north of Hokkaido Island. For this region the mechanism was determined for one earthquake: on 28 January at 17:01 (H=100 km). This earthquake occurred under the conditions of a horizontally oriented compression stress and a more steeply oriented tension stress. One of the possible fault planes--plane I--has a strike southeast-northwest and dips to the southwest (under Hokkaido Island). The shift in this plane is of a strike-slip thrust nature, with the southwestern limb undergoing an uplift relative to the northeast limb. The strike of the second of the possible fault planes--northeast-southwest--also dips to the northwest, and strike-slip thrust fault shifts also occurred along it.

For another group, located at the northwest edge of the deep-sea Southern Okhotsk basin, an approximately uniform focal mechanism is characteristic. One of the possible fault planes has a northeast-southwest strike, and dips toward the southeast. The nature of the shift for this plane is strike-slip thrust fault, with the southeastern limb elevated relative to the northwest. The second of the possible fault planes, which has a strike close to meridional, and a dip to the west, is characterized by a strike-slip thrust fault shift. The western limb is elevated relative to this plane.

It can be seen from the table that these earthquakes occurred under conditions of a horizontally oriented compression stress and a more steeply oriented tension stress.

The third group of deep earthquakes was located in the Sea of Japan, in the region of the city of Vladivostok. A uniform focal mechanism was also characteristic of the earthquakes of this group. One of the possible fault planes is of a strike close to meridional. The shift for this fault plane has a strike-slip thrust fault nature, with the western limb elevated in relation to the eastern. As for the second possible fault plane, its strike is northeast-southwest and the dip is to the east. For this plane the southeast limb is elevated in relation to the northwestern limb.

The following group of deep earthquakes, for which the focal mechanism was determined, is located in the northern part of the Sea of Okhotsk. These earthquakes occurred under the conditions of a horizontally oriented tension stress and a more steeply oriented compression stress. One of the possible fault planes in the focal points of these earthquakes has a northeast-southwest strike and dips to the southeast. The nature of the shift in this fault plane is strike-slip normal fault, with the southeastern limb dropped in relation to the northwestern. The strike of the second of the nodal planes is northwest-southeast and dips to the southwest; the southwest limb of the fault along this plane dropped in relation to the northeastern. A study of the mechanism of the focal points of the deep earthquakes made it possible to discover that for most of the deep earthquakes a nearly horizontal oriented compression stress and a more steeply oriented tension stress is characteristic, with the exception of the earthquakes in the northern part of the Sea of Okhotsk, where the tension stress was oriented close to horizontal.

Catalog of Earthquakes in the Kuril Islands and Sea of Okhotsk With $K \geqslant 9$ in 1973

№ п/п	Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	Класс точности	*M*	*K*	№ района	Макросейсмические данные
			$\varphi^o N$	$\lambda^o E$						
1	2	3	4	5	6	7	8	9	10	11

Key:

1. Number, in order
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ °N
5. Coordinates of epicenter: λ °E
6. Focal depth, in km
7. Accuracy class
8. M
9. K
10. Number of region
11. Macroseismic data

January

3	06 17 16	50,6	157,2	10–40			10,5	1	
4	13 35 56	50,2	157,1	40	Б		10,5	1	
5	13 39 52	47,6	146,9	450	А			8	
6	15 04 18	43,1	147,9	40			9,5	5	
	15 05 41	49,2	155,9	40	А	4,3	10,5	2	
	15 38 44	43,0	147,7	40	А		10,0	5	
	15 40 45	49,9	155,9	40	А		9	1	
7	20 06 57	47,5	153,9	70	А		9	2	
8	23 17 25	50,4	157,5	40			9,5	1	

1	2	3	4	5	6	7	8	9	10	11
	9	08 58 45	53,3	154,0	500	А			8	
		16 02 17	43,7	147,0	80	А		9	5	
	11	15 35 50	47,3	153,1	100	Б			2	
		16 21 41	43,5	146,3	70	А		9,5	5	
	15	01 53 13	45,9	142,4	345	А			8	
		12 23 12	49,3	152,3	20			9,5	8	
	16	17 59 43	42,3	143,3	40			9,5	6	
	17	17 03 01	47,4	148,2	350	А			8	
	18	11 46 28	45,7	144,1	300	А			8	
	20	22 41 13	45,7	150,6	105	А			3	
	21	07 36 05	49,2	156,2	0–10	Б		10	1	
		13 18 28	47,1	153,8	40			9,5	2	
		18 10 06	51,3	159,0	0–10	Б		9,5	1	
	22	02 31 04	44,1	147,3	50	Б		9	5	
		03 39 04	45,3	152,7	40			9,5	3	
		08 42 44	43,5	146,1	95	А		9	5	
		19 39 27	46,5	152,5	20	А		9	3	
	23	16 47 48	45,4	150,8	40	Б		9	3	
		18 32 07	43,1	148,3	40			9,5	5	
	24	09 01 55	43,6	140,9	190	Б			7	
	25	10 48 47	43,7	146,6	50	А		9,5	5	
	26	07 16 54	50,8	157,7	20–30	А		10	1	
		07 17 57	50,7	157,6	50			9,5	1	
		22 02 07	43,4	146,8	55	А		9,5	5	
	27	01 45 45	44,4	148,1	40	А		9	4	
		04 04 42	50,3	156,8	60	А	4,6	11	1	о-в Шумшу, 4 балла; Паужетка, 3 балла; Северо-Курильск, 2–3 балла
	28	00 59 25	44,5	148,6	90	Б			4	
		17 01 50	41,8	141,0	100	А			7	
	29	16 48 41	50,22	159,80	30	А		9,5	1	
		21 42 40	48,4	154,8	40			9	2	
	30	00 26 07	45,4	151,3	40	А		9	3	
		18 01 06	48,6	156,1	40		4,0	9	2	
					February					
	3	14 24 20	49,4	156,8	0–50			10,5	1	
	4	01 16 12	50,8	157,2	75	Б		10,5	1	
	5	04 30 33	43,6	147,8	55	А	4,4	10,5	5	
		05 37 48	49,7	156,0	40			9,5	1	
	7	07 20 10	43,9	145,5	150	А			5	
	8	02 35 06	49,6	156,1	40	Б		10,5	1	
	9	05 39 42	43,1	146,5	40	Б		9	5	
	10	16 55 38	49,8	156,3	70	А	5,3	11,5	1	м. Васильева, 3–4 балла; Северо-Курильск, 2–3 балла
	11	12 38 00	46,2	152,7	30	Б		9	3	
	13	08 27 01	49,80	156,80	10–50			9,5	1	
	14	06 45 59	51,6	156,3	200	Б			1	
	15	14 53 11	46,8	153,2	30	Б		9,5	3	
		14 57 51	45,9	154,8	40			9	3	

1	2	3	4	5	6	7	8	9	10	11
	15	22 17 39	47,1	154,0	30	Б		9,5	2	
	16	13 15 13	43,9	147,6	40	А		9	5	
	17	06 30 36	42,0	142,8	40	Б		10	5	
1		19 15 14	45,0	148,8	130	А	5,5		4	
	19	11 10 22	49,4	158,4	10–40			9,5	1	
		16 26 46	47,3	144,5	420	А			8	
	21	11 37 50	45,0	147,0	80	А		9	5	
	22	18 51 06	44,6	141,0	250	А			7	
		18 58 24	44,6	149,0	40	А		9	4	
		20 20 10	43,3	138,9	200	А			7	
	23	07 02 30	47,3	153,8	40	А		10	2	
		14 33 30	47,5	154,3	40			9	2	
	24	02 07 47	43,2	146,2	50	Б		9	5	
	25	02 21 52	50,2	157,0	10–40	Б		10	1	
		03 54 14	44,5	148,4	60	А		10	4	
	26	08 16 58	49,2	156,0	40	А	4,4	10,5	2	
		15 56 46	43,6	146,6	25	А		9	5	
		17 07 49	50,4	157,0	10–20	Б		9,5	1	
		17 08 50	50,2	156,7	60	Б		9,5	1	
		18 00 11	50,8	160,4	40	Б		10	1	
		22 45 41	42,1	134,3	400	Б			7	
	27	06 41 59	43,9	147,3	40			9,5	5	
		07 31 50	43,1	146,1	40	Б		9,5	5	
2	28	06 37 54	50,4	156,7	70	А	7,5		1	See separate article
3		06 41	50,2	157,2	0–40			12,5	1	
		06 43	50,2	157,2	0–40			10	1	
		06 45	50,4	156,8	10–40			9	1	
		06 46 59	50,4	156,8	10–40			10	1	
		06 49 34	50,6	157,4	30	А		10,5	1	
		06 50 42	50,3	157,1	30	А		11,5	1	
		06 55 40	50,1	157,1	55	А		11	1	
		06 58	50,2	157,3	0–40			10,5	1	
		07 14	50,4	156,8	10–40			10	1	
		08 05 51	50,1	157,1	30	А		9,5	1	
		08 07 48	50,5	157,4	30	А		10	1	
		08 12 12	50,2	157,0	70	Б		10	1	
		08 14 27	50,5	157,2	50	Б		11	1	
		08 23 23	50,1	157,0	70			9,5	1	
		08 31 40	50,4	157,6	60	Б		9,5	1	
		08 47 17	49,7	156,8	40			9,5	1	
		08 54 17	50,4	156,2	70	Б		9	1	
		10 18 42	50,1	156,9	60	А		11	1	о-в Шумшу, 3 балла; м. Васильева, 2–3 балла; Северо-Курильск, 2–3 балла
		11 32 44	50,1	157,0	60	А	5,2		1	м. Васильева, 3–4 балла; Северо-Курильск, 2–3 балла
		11 45 27	50,1	157,0	60	Б		10	1	
		12 02 13	50,3	156,9	30			9	1	
		12 33 10	50,1	156,9	70	Б		9,5	1	

1	2	3	4	5	6	7	8	9	10	11
		12 34 42	50,1	156,9	60	Б		9	1	
		13 45 25	50,1	157,0	50			9	1	
		14 03 59	50,1	157,0	60	А		10,5	1	
		15 08 20	50,3	156,9	40	Б		9,5	1	
		17 21 28	50,3	157,2	10–40			9,5	1	
		17 58 19	50,2	157,0	60	Б		10	1	Северо-Курильск, 2–3 балла
		17 31 11	49,8	157,3	40			9,5	1	
		19 09 44	50,2	157,0	40			9	1	
		20 16 20	50,4	157,6	40	Б		10	1	
		20 35 51	50,1	157,2	40	Б		9,5	1	
		20 48 05	50,0	157,1	40			9	1	
		22 01 03	50,2	156,8	50	Б		10	1	То же
		23 28 55	46,2	151,6	85	А		9	3	
					March					
	1	02 12 54	50,2	156,9	50	Б		9	1	
		02 19 06	50,0	157,1	45	А	5,1	11	1	
		03 04 47	50,2	157,1	40	Б		9	1	
		04 10 34	49,6	157,6	50	А		10	1	
		04 29 58	50,1	156,7	50	А		10,5	1	
		04 48 47	50,0	157,1	60	А		10	1	
		07 50 03	50,5	157,4	40			9	1	
		09 33 13	50,0	157,1	50	Б		9,5	1	
		10 14 37	50,0	157,0	40	Б		9,5	1	
		10 31 23	49,5	155,6	40	Б		9	2	
		10 36 19	50,1	157,0	40	А		10	1	
		12 11 47	49,7	157,2	40	А		9	1	
		12 22 10	49,8	157,2	40			10	1	
		13 26 38	48,2	155,1	40	Б		10	2	
		13 46 34	50,2	156,6	50	Б		10	1	
		16 30 00	50,4	157,3	40	Б		10	1	
		16 44 28	50,5	157,7	40	Б		10	1	
		17 04 16	50,4	157,2	40	Б		9,5	1	
		18 14 26	50,0	157,3	40			9	1	
		22 00 39	50,4	156,9	30	Б		10	1	
		22 21 02	50,2	157,8	40	Б		9,5	1	
	2	01 29 38	50,0	157,5	40			9	1	
		06 32 47	50,6	157,2	40			9,5	1	
		06 53 55	50,4	157,0	40			9	1	
		07 08 41	50,3	156,7	10			9	1	
		08 07 50	50,3	157,1	30			9,5	1	
		10 24 44	50,0	157,2	40	Б		10	1	о-в Шумшу, 3–4 балла; Северо-Курильск, 2 балла
		11 11 38	50,6	157,3	30	А		10	1	Северо-Курильск, 1–2 балла
		13 57 01	50,4	157,0	20	А		9,5	1	
	3	02 42 11	50,2	156,4	65	А	5,0	11	1	м. Васильева, 4–5 баллов; о-в Шумшу, 4 балла; Северо-Курильск, 3–4 балла

1	2	3	4	5	6	7	8	9	10	11
		06 29 11	50,0	157,2	40	Б		9	1	о-в Шумшу, 2–3 балла
		08 21 08	45,4	150,4	40	Б		9,5	3	
		09 12 10	50,2	157,0	50	А		10	1	Северо-Курильск, 1–2 балла
		18 27 47	50,3	157,2	20	Б		9,5	1	
	4	03 48 44	50,1	156,9	0–10	Б		9,5	1	
		06 59 01	50,4	157,7	40	А		10	1	
		08 28 37	50,5	157,1	55	А		10	1	Северо-Курильск, 2–3 балла
		08 41 15	49,5	157,0	0–50			9,5	1	
		09 29 16	50,1	157,2	40	А		9,5	1	о-в Шумшу, 2–3 балла
		11 24 48	49,8	157,6	60	А		10	1	Северо-Курильск, 1–2 балла
		22 53 16	48,5	156,0	40	А		10	2	
	5	06 15 56	50,5	157,6	60	А		10	1	Северо-Курильск, 2–3 балла
		06 20 42	43,2	145,5	140	А			5	
		07 42 53	42,0	142,7	60	А		10	6	
		10 00 20	50,0	157,3	40	Б		10	1	
		10 14 57	50,5	157,7	40	А		10	1	Северо-Курильск, 2–3 балла
		15 48 02	49,7	157,7	40			9	1	
		17 44 29	45,8	153,4	40			9	3	
		19 49 00	50,1	156,8	70	А		10	1	
		21 39 51	43,5	148,0	40	Б		10	5	
	6	02 19 14	50,4	157,0	0–10	Б		9	1	
		08 29 55	50,7	157,4	40	Б		9	1	
		15 01 08	46,9	154,2	40			9	2	
		18 32 08	49,9	157,1	50	А		11	1	
		20 09 43	50,0	157,1	40	Б		10	1	
		20 42 41	49,6	157,6	40			9	1	
	7	02 53 17	46,3	153,2	40			9	3	
		03 31 48	50,4	157,1	10	Б		9,5	1	
		16 11 55	44,3	148,4	40	Б		10	4	
		16 16 46	47,8	146,8	460	Б			8	
	8	03 00 24	50,4	157,0	10	Б		9,5	1	
		05 33 23	49,6	157,8	40			10	1	
		06 06 28	50,3	157,2	0–20	Б		9,5	1	
		14 44 16	50,3	157,8	40			10	1	
		15 02 48	43,8	147,7	40	Б		9	5	
		15 03 20	50,4	157,2	0–10	Б		9	1	
		15 18 10	50,6	157,4	40	А		9	1	
		20 12 28	50,6	157,3	40	А		10	1	
		21 47 26	42,4	143,8	40	Б		9	6	
		23 13 59	50,3	157,7	40			10	1	
	9	01 26 50	47,9	147,0	475	Б			8	
		02 08 29	48,1	154,9	20	А		10	2	
		04 36 58	49,1	155,3	40	А		9	2	
		13 58 44	49,9	157,2	50	А	5,0	11	1	

1	2	3	4	5	6	7	8	9	10	11
	9	14 46 44	50,5	157,5	40	Б		10	1	
		15 55 25	49,8	158,0	40			9,5	1	
		19 41 35	48,6	154,7	40	А		10	2	
		22 29 37	50,1	156,8	40	Б		9,5	1	То же
	10	04 44 46	50,5	157,0	60	А		11	1	
		06 28 00	50,2	157,0	0–50			9,5	1	
		08 05 51	48,3	153,8	25–30	А		9	2	
		15 33 08	48,6	155,3	50	Б		9,5	2	
		16 07 44	48,6	155,4	40	Б		9	2	
		22 34 09	50,1	156,8	40	Б		9,5	1	Северо-Курильск, 3 балла
		23 21 26	42,9	146,7	40	Б		9,5	5	
	11	02 39 06	50,0	156,9	40	Б		10,5	1	
		08 14 05	42,5	143,0	80	А		9	6	
	12	09 57 20	45,7	150,3	40	Б		10	3	
		10 04 33	43,5	148,2	40	Б		9,5	5	
4		11 14 25	50,1	156,7	55	А	5,6		1	Северо-Курильск, 3–4 балла, Паужетка, 3 балла
		19 13 14	49,8	157,7	30	Б		10	1	
5		19 39 21	50,8	157,2	70	А	6,3		1	Северо-Курильск, о-в Шумшу, 5–6 баллов
	13	11 26 38	44,3	146,1	130	А			5	Северо-Курильск, 2–3 балла
		23 17 30	50,1	157,2	40	Б		10	1	
	14	04 04 23	49,4	159,0	20			9,5	1	
	15	00 19 22	51,1	159,6	10–20	Б		10	1	
	16	21 44 09	51,1	156,9	90	Б			1	
	17	00 10 19	46,1	153,5	40	А		10	3	
		10 52 57	49,8	158,1	40			9,5	1	
		18 26 59	50,5	157,5	40			9	1	
	18	17 06 59	43,7	148,6	40	Б		9	5	
		21 09 52	43,3	146,1	40	Б		9	5	
	20	02 46 36	50,1	157,1	40	Б		9,5	1	
		07 59 20	45,5	150,0	40	Б		10	3	
		14 27 56	48,3	155,9	40	Б		10	2	
		21 53 09	44,3	148,0	70	А		9	5	
6	21	02 24 21	50,7	157,2	65	А		11,5	1	о-в Шумшу, 4 балла; Северо-Курильск, 1–2 балла
		06 14 20	50,2	156,8	0–50			9	1	
		21 46 13	48,7	153,7	105–110	А	5,1		2	
	22	15 28 06	44,6	148,9	40	Б		10	4	
		17 14 47	44,6	149,1	40	Б		9,5	4	
	23	03 59 12	50,2	157,0	40	Б		10,5	1	Северо-Курильск, 1–2 балла
	24	02 50 56	50,2	157,2	40	Б		9,5	1	
		05 22 53	45,4	151,0	40			9	3	
		07 14 26	51,5	161,7	35	А		11	1	

1	2	3	4	5	6	7	8	9	10	11
	25	08 56 16	49,9	157,3	25–30	А	5,3	11	1	Северо-Курильск, 5 баллов; о-в Шумшу, 3–4 балла
		12 42 31	52,2	152,5	510	А			8	
		13 34 59	45,8	151,4	70	А		11	3	
		14 27 54	42,8	145,7	40	Б		9,5	5	
		21 11 06	50,2	156,6	40	Б		10,5	1	о-в Шумшу, 4 балла; Северо-Курильск, 3 балла
	27	05 04 24	45,1	149,4	40	Б		9	4	
		06 46 11	43,6	147,1	40	Б		9,5	5	
		13 58 25	50,6	157,3	30	Б		10	1	
		16 56 25	49,7	156,3	40	А		10,5	1	
	28	03 30 50	42,6	144,2	50	А	4,5	10,5	6	
	31	09 03 26	48,6	154,9	40	Б		9,5	2	
		14 01 03	46,8	153,0	40	А		10,5	3	
		20 45 32	50,1	156,9	50	А		11	1	Северо-Курильск, 1–2 балла
					April					
	1	09 37 20	49,6	156,1	40	А		10	1	
		22 21 41	49,4	155,9	40	Б		9,5	1	
	2	20 22 23	49,6	156,7	40	Б		9,5	1	
	3	10 50 29	45,7	151,4	50	А	4,5	11	3	
		16 19 21	50,2	156,9	40	Б		9,5	1	
	4	10 12 54	44,3	148,3	30	А		10	4	
		13 25 24	49,9	153,6	290	А			8	
		16 08 03	45,5	149,3	90	Б			4	п. Буревестник, 3 балла
		21 31 29	43,3	147,9	30–40	А		10	5	
		21 50 55	43,5	147,8	35	А	5,1		5	
		23 56 44	43,3	143,9	35	А	5,1		5	
	5	01 01 58	43,2	147,8	40	А		10	5	
		12 14 15	43,2	146,6	30	А		9,5	5	
		18 51 04	50,1	156,8	40			9	1	
		19 00 14	50,0	157,0	40	А		9	1	
7		22 17 00	43,6	147,8	47	А	6,0		5	
		22 35 28	43,3	147,9	30	А		11,5	5	
		22 41 56	43,3	147,9	30	А	4,5	10	5	
		23 06 51	43,3	147,9	30	А	4,5	10	5	
		23 32 21	43,3	147,9	30	А		9,5	5	Малокурильское, 2–3 балла
		23 33 58	43,3	148,0	30	А	4,9		5	
	6	00 00 44	43,4	147,9	30	А		10,5	5	
		00 01 57	43,4	147,8	30	А	5,3	11,5	5	
8		01 48 00	44,2	147,2	25	А	5,7		5	
		01 54 37	44,0	147,2	30	Б		9,5	5	
		01 57 11	43,4	147,8	30	А		9,5	5	
		02 13 05	43,3	147,8	30	Б		9,5	5	
		03 04 24	43,3	148,0	30	Б	4,0	9,5	5	
		03 42 16	43,3	148,0	30	Б		9,5	5	
		03 51 49	43,3	148,0	30	Б		9,5	5	
		03 53 48	43,3	148,0	30	Б		9	5	
		05 40 55	43,4	147,7	30	А	4,2	10	5	
		05 44 24	43,3	147,9	30	Б		9,5	5	

1	2	3	4	5	6	7	8	9	10	11
	6	07 09 20	43,3	147,8	30	А		9,5–10	5	
		07 12 07	43,2	147,9	20	А		9,5–10	5	
		07 32 11	43,3	147,8	30	А	4,0	9–9,5	5	
		09 21 58	43,3	148,0	30	Б		9,5	5	
		10 44 02	43,3	148,0	10	А		10,5	5	
		12 28 39	43,3	148,0	30	Б		9,5	5	
		14 45 51	43,3	148,0	30	А	4,3	10	5	
		14 56 38	43,3	148,0	30	Б		9,5	5	
		14 58 02	43,4	147,9	30	А	4,7	11	5	
		15 09 04	43,3	148,0	30	А	4,6	10,5	5	
		18 48 53	43,3	148,0	30	Б		9,5	5	
		19 05 05	43,3	148,0	30	Б		9,5	5	
		19 07 41	43,3	148,0	30	Б		10	5	
		21 31 40	45,9	152,3	40			9	3	
		23 28 50	43,3	148,0	30			9	5	
	7	04 42 28	43,3	148,0	30	Б		9,5	5	
		07 24 10	46,2	153,3	40	Б		9	3	
		11 04 45	50,1	156,9	40	Б		9,5–10	1	
		15 33 32	50,1	157,1	40	А		10,5	1	Северо-Курильск, 2–3 балла
		16 04 14	43,3	148,0	20	А		10	5	
		16 32 12	43,3	148,0	30			9	5	
		17 09 56	44,6	144,1	240	Б			8	
		17 37 08	43,3	148,0	30	А		9	5	
		23 34 06	43,3	148,0	30	Б		9,5	5	
	8	04 49 41	42,4	148,8	40	Б		9,5	5	
		06 39 28	52,0	158,8	20	Б		11	1	
		06 55 37	43,3	148,0	30	Б		9	5	
		12 23 27	50,6	157,7	40	А		9,5–10	1	
9		21 55 01	47,2	152,2	110–120	А	6,3		3	
	9	08 27 11	49,8	156,8	40	Б		9,5	1	
		11 52 19	52,3	152,6	470	А			8	
	10	23 56 28	50,2	157,4	60			9,5	1	
	11	20 53 45	42,1	142,6	60	А		10	6	
	12	02 31 49	43,6	146,7	50	А		10	5	
		06 35 34	43,1	147,6	40			9	5	
		12 17 18	49,9	156,0	65	А	4,5	11	1	м. Васильева, 3 балла; Северо-Курильск, 2 балла; о-в Шумшу, 5–6 баллов; Северо-Курильск, 4–5 баллов; м. Васильева, 4–5 баллов
10		13 49 15	50,7	157,6	70	А	6,3		1	
		14 32 37	50,8	157,4	70	А		10,5	1	
	13	10 29 36	50,8	157,6	40	А		9,5	1	
		18 17 34	43,4	147,7	30	А		9,5	5	
		06 01 28	50,5	157,7	40	Б		9,5	1	
		06 34 40	42,9	147,6	40			9	5	
		16 14 01	49,7	156,1	40			9,5	1	
	15	03 13 13	50,6	157,8	30	А		10,5–11	1	Северо-Курильск, 3 балла

1	2	3	4	5	6	7	8	9	10	11
	16	20 09 03	48,0	154,3	30	А		10	2	
11	17	22 09 51	50,8	157,6	60	А	5,7		1	Северо-Курильск, 2–3 балла
		22 21 39	50,7	157,6	30	А		10	1	
	18	06 24 35	43,8	147,1	60	А		9,5	5	
		09 31 16	44,5	147,0	170	А			5	
	19	15 25 12	42,8	148,3	10	Б		9,5	5	
		21 33 45	42,1	142,6	20	А		10	6	
	21	10 30 32	43,7	147,7	40	Б		9	5	
		12 54 44	44,4	148,2	40	Б		9	4	
		13 49 40	49,9	156,3	40	Б		9,5	1	
		23 06 55	47,7	155,8	40			9,5	2	
	22	01 47 54	44,7	148,6	70	А		10,5	4	
	23	19 59 17	46,9	153,0	40	А		10	3	То же
	24	03 35 34	50,0	157,1	40	А		10	1	
		05 20 19	44,5	148,2	40	А		10	4	
		10 48 18	43,1	147,0	40	Б		9	5	
		19 42 57	43,5	146,8	45–50	А		9	5	
		20 15 43	48,6	155,0	35	А		10	2	
		21 02 17	50,4	157,6	40			9	1	
	25	00 00 32	49,8	156,8	40	Б		9,5	1	о-в Матуа, 4–5 баллов
		02 23 37	52,0	159,0	40	А		9,5	1	
		08 52 06	43,2	148,4	40			9	5	
		18 27 48	47,7	152,7	120	Б			2	
	27	01 37 06	43,3	146,8	40	А		9	5	
		08 56 37	43,8	147,7	40	А		9,5	5	
		15 19 56	43,6	144,9	125	А		9,5	5	
		19 13 13	48,2	154,9	40			9	2	
	29	09 10 55	50,7	157,7	40	Б		9,5	1	Северо-Курильск, 2 балла
		11 51 23	42,2	142,5	60	Б		9	6	
					May					
	1	00 52 39	44,0	148,6	25	А	4,5	10	4	
		12 53 38	45,8	143,3	340	А			8	
		14 59 20	45,5	150,8	40	А		9	3	
		17 17 21	49,8	156,8	40	А		10	1	
		20 44 38	45,2	152,2	40	Б		9	3	
		22 32 08	45,4	152,3	40	Б		9,5	3	
	2	05 19 03	44,0	148,5	30	А	4,5	10	5	
		11 25 34	50,4	157,0	30	Б		9	1	
	3	03 04 28	46,6	153,6	40			9	3	
		04 36 38	50,7	158,0	50	А		10	1	
		07 10 16	49,0	156,1	40	Б		10,5	2	
		19 43 17	50,5	161,2	20	Б		10	1	
	4	02 59 17	50,5	157,1	25	А		9,5	1	
	5	03 37 16	42,1	145,6	50	А		10	6	
		08 46 37	42,7	142,3	110	А			6	
		09 52 26	45,7	152,6	50	А		9,5	3	
		16 15 07	44,1	146,7	135	А			5	
		23 31 52	49,8	156,3	30	Б		9,5	1	
12	6	14 39 30	43,4	132,4	500	А	5,9		8	
	7	17 57 15	50,0	156,8	40			9,5	1	

1	2	3	4	5	6	7	8	9	10	11
	8	04 36 01	45,9	150,0	145	А			3	
		07 49 00	45,6	149,8	107	А	6,0		3	о-в Уруп, 3–4 балла
		13 20 20	44,1	149,3	40	Б		9	4	
	9	04 06 39	46,4	152,8	40	Б		9	3	
	10	07 31 50	49,7	153,9	190	А			2	
		19 16 21	50,2	157,6	50	А	4,5	11	1	
		20 45 02	48,0	148,9	350	Б			8	
		23 31 48	49,8	156,7	40			9,5	1	
	11	03 18 04	51,3	158,8	40	Б		10	1	
	12	09 20 07	50,0	156,6	0–10	А		9,5–10	1	
		09 38 21	48,1	154,6	40	Б		9,5	2	
		11 59 44	49,9	157,0	30			9	1	
	13	00 53 54	48,8	156,4	40			9,5	2	
		12 03 59	50,3	156,8	60	А		10	1	
		18 07 48	43,8	148,7	40	Б		9,5	4	
	14	02 19 02	44,1	148,3	60	А		11	5	
		23 48 34	45,8	143,0	360	А			8	
	15	03 18 51	42,0	142,2	90	А			6	
		03 54 52	50,6	159,6	10	Б		9,5	1	
		05 39 27	49,8	157,0	40	Б		9,5	1	
		11 41 40	43,9	148,0	40	Б		9	5	
		23 48 02	44,8	147,4	145	Б			5	
	16	09 14 28	50,9	157,7	10	Б			1	
	17	04 06 10	44,0	147,0	95	А			5	
		06 17 51	44,7	149,4	50	А		11	4	
	18	06 10 02	42,2	143,1	40	А		10	6	
		10 36 52	44,5	149,4	55	А	5,3		4	
		21 03 54	44,1	148,2	30	Б		9	5	
		22 07 32	51,4	158,3	20	Б		9	1	
	19	07 29 26	50,4	157,1	40	Б		9	1	
	20	13 58 07	43,1	147,1	100	Б			5	
		18 47 17	50,2	157,2	40	Б		9,5	1	
	21	09 16 47	47,6	152,5	140	А			2	
	22	04 22 14	44,5	148,6	60	А		10	4	
		05 26 29	44,1	147,7	40			9	5	
		20 05 19	45,4	150,2	40	Б		9	3	
		20 32 50	45,4	150,2	40	Б		9	3	
	23	01 41 45	49,7	156,7	40	Б		9,5	1	
		15 59 29	49,8	156,4	40	А		10,5	1	
		16 03 43	49,9	156,8	40			9,5	1	о-в Матуа, 4–5 баллов; Северо-Курильск, 2–3 балла; м. Васильева, 2–3 балла
	24	14 37 50	46,3	153,0	40			10	3	
		17 25 23	43,3	146,4	40	Б		9	5	
		20 04 07	50,0	157,1	30	Б		9,5	1	
		20 54 18	45,4	150,8	40	А		10	3	
		21 02 00	45,2	151,4	40			9	3	
	25	12 48 07	42,9	145,4	40	Б		9	6	
		16 56 15	45,4	150,9	40	А		10	3	
		18 59 27	47,7	154,6	40	А		10	2	
	26	08 15 46	44,0	151,8	25	А		9,5	3	
		23 04 45	46,4	153,0		Б		9	3	
	28	19 35 56	45,5	151,4	40	Б		9,5	3	

1	2	3	4	5	6	7	8	9	10	11
					June					
	1	20 38 39	43,4	146,0	40	Б		10	5	
	2	02 29 43	48,8	155,2	40	Б		10	2	
		12 23 00	43,7	147,8	40			9,5	5	
	3	06 57 28	48,9	156,4	40	Б		9,5	2	
	5	07 14 11	48,7	156,3	40			9	2	
		10 44 15	43,2	146,6	40	Б		9	5	
		10 53 56	50,5	157,0	0–10	А		9,5	1	
		18 19 00	42,3	143,9	40	Б		9	6	
	6	03 47 18	43,9	147,2	50	А		10	5	п. Малокурильское, 3–4 балла
		06 57 28	48,9	156,4	40	Б		9,5	2	
		11 49 30	43,1	145,9	50	А		10	5	
		16 28 00	49,8	157,9	40	Б		10	1	
		20 04 39	44,4	148,3	40	А		10	4	
	8	00 23 07	45,5	151,2	40	А		10	3	
		12 05 11	42,9	146,6	40			9	5	
		12 21 28	51,0	157,0	40	А		10,5	1	
	9	03 43 06	44,0	151,8	10–20	А	4,5	11	3	
		08 38 00	50,6	157,6	40	А		10	1	
	10	05 07 45	44,3	148,7	40			9	4	
13	13	00 20 52	46,6	151,5	175	А	6,1		3	о-в Уруп, 3 балла
		00 41 48	48,2	155,0	40	Б		9,5	2	
		17 02 37	44,0	149,2	40	А		10	5	
	14	11 46 35	48,0	154,0	60	А		9	2	
		18 48 52	51,0	157,6	60–70	А		9	1	
	15	05 28 41	44,5	149,4	40			9	4	
	16	00 54 34	43,0	146,1	50	А	4,4	10	5	
		01 36 33	42,8	144,8	55	А	4,2	10	6	
14	17	03 55 02	43,2	145,8	50	А	7,9		5	See separate article
15		04 09 11	42,6	146,5	35	А		13	5	п. Малокурильское, 2–3 балла; Южно-Курильск, 2–3 балла
16		04 19 33	42,4	145,8	45	А		12	6	
		05 09 58	42,9	146,4	30	А		11	5	
17		05 12 08	42,5	146,3	30	А		12	5	
		05 52 11	42,9	146,2	40	А		11	5	
		06 08 20	42,8	146,3	40	А		10,5	5	
		06 29 30	43,0	146,3	40	А		10	5	
		06 47 52	43,0	146,3	60	Б		10	5	
		07 00 24	42,4	145,8	20	А		10	6	
		07 40 51	43,2	145,8	30	Б		10	5	
		07 46 42	42,8	145,7	30	А		10,5–11	5	
		08 17 48	42,9	146,6	45	А	4,7		5	
		08 40 50	42,7	146,3	30	А	4,5	10,5	5	
		08 48 20	43,0	146,5	45	А	5,1		5	
		08 55 30	42,3	146,2	20	А	4,7	10,5	5	
		09 18 19	42,9	146,6	20	А	4,4	11	5	
		09 28 48	42,4	147,0	40	Б	4,5	10	5	

1	2	3	4	5	6	7	8	9	10	11
		10 06 04	42,7	146,7	30	А	4,5	10	5	
	17	10 24 13	42,3	145,7	25	А	4,2	10	6	
		10 29 19	42,8	147,1	40	А	4,4	10,5	5	
		11 19 50	42,6	146,0	40	А	4,5	10	5	
		11 35 31	42,8	146,6	30	А	4,4	10,5	5	
		11 45 22	42,8	146,7	40	Б	4,5	10	5	
		11 49 11	43,2	145,9	40	А	4,5	10	5	
		12 14 26	42,8	145,5	45	А	4,8	11	6	
		12 19 22	43,2	145,8	40	А	5,0	11	5	
18		12 24 36	42,6	146,4	45	А	5,7		5	
		13 22 18	42,6	146,0	30	А	4,5	10	5	
		13 33 28	42,9	145,5	45	А	5,3	11,5	5	Южно-Курильск, 2–3 балла
19		13 43 07	42,7	146,9	45	А	5,5		5	
		14 24 14	42,5	145,6	50	А	4,6	10,5	6	Южно-Курильск, 1–2 балла,
		14 39 08	42,9	145,7	40	Б	4,5	10	5	
		15 07 55	42,5	145,8	40	Б		10	6	
		16 29 53	43,0	145,6	40	Б	4,5	10	5	
		18 22 03	42,8	146,0	40	А		9,5	5	
20		18 55 40	42,7	146,7	45	А	5,6		5	
21		19 03 33	42,5	146,6	25	А	5,5		5	
22		20 38 00	42,5	146,1	60	А	6,4		5	
		21 03 37	42,8	146,2	40	А	5,0	11	5	
		21 23 04	42,6	146,3	40	А	4,5	10	5	
		21 23 43	42,6	146,3	30	А	4,5	10	5	
		21 26 14	42,9	145,5	55	А	5,0	11	5	
		22 15 30	42,7	145,8	20	А	4,8	10,5	5	Южно-Курильск, 7 баллов
	18	01 09 00	42,8	146,7	40	А		10	5	
		02 12 07	42,5	147,0	40	А	5,2		5	
		02 19 33	42,8	146,1	30	А	5,0		5	
		04 22 58	42,7	146,6	25	А		10,5	5	
		04 32 37	42,8	146,5	40	А		10	5	
		04 55 14	42,5	146,4	20	А		10,5	5	
23		05 37 36	42,5	146,6	45	А	5,4		5	
		09 54 16	43,1	145,5	50	А		10	5	
		11 36 37	42,6	146,0	20	А		10	5	
		13 13 50	42,5	146,1	20	А		10	5	
		14 29 37	43,1	147,5	20	А	4,4	10	5	
		14 31 38	43,1	147,5	35	А		10	5	
		15 54 02	42,8	146,0	40	А		10	5	
		17 04 37	42,7	147,3	40	А		10	5	
24		17 45 43	42,3	146,1	25	А	6,0		6	
		18 24 20	42,3	145,5	30	А	5,0		6	
		19 06 58	42,7	145,6	40	Б		10	6	
		20 31 35	42,5	146,5	20	А	4,8		5	
		23 55 38	42,5	145,6	30	А		10	6	
	19	02 00 17	42,4	146,1	20	А		10	5	
		02 22 06	43,0	146,7	35	А	5,3		5	п. Малокурильское, 3–4 балла
25		02 54 11	42,7	146,1	50	А	5,7		5	
		04 29 24	42,2	146,0	25	А		10,5	6	

1	2	3	4	5	6	7	8	9	10	11
	19	05 14 19	42,6	146,3	35	А		10,5	5	
		06 26 13	42,4	145,8	50	А	4,9		6	
		06 37 53	42,7	146,7	50	А	5,0		5	
		07 35 48	42,6	146,3	20	А	4,2	10	5	
		08 36 18	43,0	146,4	50	А	5,0		5	Южно-Курильск, 2–3 балла
		09 37 19	42,8	146,5	45	А	4,6	11	5	
		10 58 47	42,6	146,7	45	А	5,0		5	
		11 40 57	42,7	146,5	20	А		10,5	5	
		12 36 55	43,1	146,0	30	А		10,5	5	
		17 10 11	42,4	146,1	20	А	5,0		5	
		20 05 51	42,6	146,5	30	А	4,8		5	
	20	04 53 32	42,6	145,6	30	А		10	6	
		06 11 36	42,7	146,2	45	А		10	5	
		06 51 42	43,2	145,8	40	Б		10	5	
		09 20 37	43,2	146,0	40	А		11	5	
		10 12 01	42,8	145,8	30	А		10	5	
		13 58 23	43,2	146,1	40	Б		10	5	
	21	01 30 28	50,4	156,9	30	Б		9,5	1	
		05 21 21	43,0	146,3	35	А		10	5	
		05 58 34	42,7	145,5	60	Б	3,8	9,5	6	
		08 05 54	43,0	147,5	40	А		10	5	
		09 11 20	46,4	154,7	40	Б		9	2	
		11 42 41	50,2	157,0	40	Б		9,5	1	
		12 52 15	42,6	146,4	20	А	4,5		5	
		16 18 03	42,8	146,5	25	А		10,5	5	
		19 47 14	47,4	155,1	40			9,5	2	
		22 16 16	42,0	146,3	40	Б		10	6	
	22	01 44 04	42,2	145,8	40	Б	4,0	9	6	
		04 24 40	42,2	146,4	40			10	5	
26		06 07 37	43,0	146,5	50	А	6,4		5	Южно-Курильск, 3 балла
		09 22 01	42,6	147,1	40			10	5	
		11 36 14	42,7	145,2	50	А		10,5	6	
		12 56 04	50,6	157,2	30	Б		9	1	
27	23	02 09 41	43,1	147,3	50	А	5,3		5	
		04 30 53	42,3	146,1	30	А	4,5	10,5	5	
		05 28 06	51,3	159,6	10			9,5	1	
		08 00 02	42,3	146,2	25	А		10	5	
		08 16 51	43,0	147,6	40	Б		10	5	
		12 04 12	42,4	146,4	40	Б		10	5	
		13 46 06	50,7	158,1	40–60	Б		10	1	
		17 13 12	51,0	158,0	40	Б		10	1	
28	24	02 43 25	43,4	1 16,5	57	А	7,6		5	See separate article
29		03 04 18	43,2	146,9	50	А	$6,0^{+}$		5	
30		03 28 36	43,2	146,8	20	А	5,9		5	
		03 40 40	43,3	147,2	35–40	Б		10,5	5	
31		403 47 48	43,0	146,5	30	А	5,4		5	
		03 54 04	43,0	146,8	30	А		10	5	
32		04 43 26	43,0	146,8	30	А	5,5		5	
33		05 07 47	43,2	146,7	53	А	5,9		5	Южно-Курильск, 4 балла
		07 08 54	42,9	147,0	50	А	5,0		5	
		08 19 46	42,9	146,9	40	Б		10	5	
		09 12 15	43,3	146,8	40	А		10	5	

1	2	3	4	5	6	7	8	9	10	11
	24.	09 49 20	42,9	146,6	30	А		10	5	
		10 28 46	43,2	146,8	25	А		10	5	
		10 40 44	42,7	146,9	35	А		10	5	
		10 53 55	43,1	146,5	50	А	5,0		5	
		12 21 04	42,8	146,8	40	А	4,3	10	5	
		17 14 56	43,2	147,1	40	Б		9,5	5	
		17 49 29	43,4	146,4	45	А		10	5	
		18 41 53	43,4	146,7	45	А	5,0		5	
		20 00 15	43,2	146,8	30	А	5,2		5	
		20 14 40	43,0	146,9	40	А		10	5	
		20 22 02	42,7	147,1	40	Б		10	5	
		20 34 38	43,2	146,5	40	Б		10	5	
		20 45 54	42,8	146,1	40	Б		10	5	
		23 12 07	43,2	146,8	40	Б		10	5	
	25	00 23 46	43,1	147,0	40	А		10	5	
		00 37 36	42,9	146,8	30	А		10	5	
		01 14 57	42,9	147,4	40	Б		10	5	
		08 19 36	43,3	146,4	45	А		10	5	
		10 32 25	43,1	147,1	40	А		10	5	
		11 37 54	46,2	153,8	20	Б		9	3	
		16 12 32	43,0	147,0	40	А		10	5	
		16 22 24	42,9	147,1	40	А		10	5	
		18 59 04	42,9	145,7	40	А		9,5	5	
		19 06 04	42,8	146,7	40	А		10	5	
		21 16 27	42,6	146,2	50	Б		10	5	
		22 02 41	46,3	153,7	40	Б		9	3	
		22 13 46	42,7	146,6	40	Б		10	5	
	26	01 09 19	44,4	148,5	40	Б		9	4	
		05 45 15	42,7	146,7	40	Б		10	5	
		11 39 24	43,0	146,8	25	А	5,1		5	
		12 18 06	42,8	146,1	35	А	4,7		5	
34		18 02 25	43,2	147,1	50	А	6,2		5	
		18 16 32	43,2	146,5	40	Б		10	5	
		20 14 49	50,5	157,1	40			9,5	1	
35		22 31 59	43,2	146,7	50	А	6,9		5	Южно-Курильск, 4 балла
		22 41 35	42,8	146,7	30	А		11	5	
		22 45 30	42,8	146,6	30	А		10,5	5	
		22 57 12	42,8	146,8	30	А		11,5	5	
		23 51 14	42,6	146,9	40	А		11	5	
	27	01 02 59	42,7	146,7	50	А	5,0	11	5	
		01 19 24	42,5	146,3	30	Б		10,5	5	
		01 41 16	43,0	146,6	50	А	5,0	11	5	
		03 15 20	43,0	147,0	50	А	5,0		5	
		03 42 42	42,8	145,7	40	А	5,0		5	
		03 53 54	42,7	146,8	40			10	5	
		11 42 18	43,0	146,4	40	Б		10	5	
		14 15 37	42,8	146,9	40	А		10	5	
		19 02 55	42,8	146,5	40	Б		9,5	5	
		20 22 27	42,4	145,6	30	А		10	6	
	28	01 30 42	48,5	154,5	40	Б		10	2	
		05 35 30	43,2	146,5	40	А		10	5	
		18 09 33	42,7	147,4	40	Б		10	5	
		19 24 28	46,5	153,8	40	Б		9,5	3	
	29	01 27 54	43,4	146,0	60	А		10	5	

1	2	3	4	5	6	7	8	9	10	11
		03 13 28	48,0	153,1	15	А	4,2	11	2	
36		03 26 53	43,3	145,8	55	А	5,5		5	Южно-Курильск, 4 балла, Малокурильское, 3 балла о-в Матуа, 6 баллов
		05 32 42	48,0	153,0	15	А		11	2	о-в Матуа, 5–6 баллов
		06 49 57	50,9	158,4	40	Б		10,5	1	о-в Матуа, 3–4 балла
		10 51 14	47,0	153,8	40	Б		9,5	2	
		12 19 22	49,1	156,4	10	А	4,5	10,5	1	
		13 35 19	42,0	146,3	10	А	4,2	10	6	
		15 44 18	42,9	146,7	10	А	3,8	10	5	
		16 39 02	43,4	146,7	25	А	4,3	10,5	5	п. Малокурильское, 3 балла
		19 21 00	43,4	146,6	40	А	4,1	10	5	
	30	00 08 30	50,3	156,8	40	А		9,5	1	
		02 54 19	43,4	146,2	40	А		10	5	
		15 30 04	43,2	145,8	40	А		10	5	

July

	1	00 39 20	46,4	150,9	65	А		9	3	
		01 14 34	49,3	153,3	210	А			8	
		01 55 13	48,1	146,4	480	А			8	
		06 01 36	43,1	146,1	50	А		10	5	Южно-Курильск, 3 балла
		10 42 48	43,2	146,5	30	А		10	5	
		15 29 18	50,1	157,2	30	А		10	1	
		17 49 19	50,9	152,7	310	А			8	
		20 40 01	48,7	155,0	40			9,5	2	
		23 27 54	43,4	146,8	40	Б		9,5	5	
	2	05 51 30	42,8	145,5	50	А	4,7	11	6	
		19 54 57	42,6	146,0	40	А		10	5	
	3	02 13 40	43,3	146,4	40	Б		9	5	
		02 54 57	43,4	146,9	50	А		10	5	
		17 04 34	45,4	150,2	40	Б		9	3	
		18 46 26	45,9	150,6	100	А			3	
		20 40 15	43,1	147,6	30			9,5	5	
	4	00 13 04	42,9	147,1	40	Б		10	5	
		01 44 35	42,8	147,6	40	А	3,8	9,5	5	
		04 45 44	43,6	146,6	40	Б		9	5	
		07 53 30	49,9	156,5	30			9,5	1	
		16 54 20	43,7	146,8	50	А		9,5	5	
		19 50 58	42,0	146,2	40	Б		9,0	6	
		20 36 49	43,3	146,4	30	Б		9,5	5	
		21 29 23	42,6	146,1	30	А	4,5	10,5	5	
		23 23 16	44,4	149,6	40	Б		9	4	
	5	00 06 52	43,0	147,3	40			9	5	

1	2	3	4	5	6	7	8	9	10	11
37		00 58 44	43,8	148,1	30	А	5,2	12	5	
		02 40 52	50,1	156,8	0–50			10	1	
		04 37 33	42,4	146,2	20	А	4,3	10	5	
		05 59 02	51,3	159,9	30	Б		10	1	
		12 21 04	43,4	146,6	30	А		10	5	
		13 02 00	42,3	146,2	40	Б		9	5	
	5	22 56 59	49,4	157,3	40	Б		9,5	1	
	6	00 15 08	51,1	160,1	20–30	Б		10	1	
		01 44 09	43,7	147,0	50	А		9,5	5	
		03 36 49	42,9	146,6	40	Б		9,5	5	
		17 15 01	42,6	146,4	40	Б		9	5	
		23 38 34	50,2	157,0	60	А		11,5	1	Северо-Курильск, 4–5 баллов; Пауженка, 3 балла; о-в Шумшу, 3 балла
	7	08 29 11	50,1	157,3	30	А		10,5	1	
	8	04 54 48	42,8	145,6	40	Б		9,5	6	
		06 29 59	43,8	146,9	45	А		9	5	
		09 59 45	43,2	146,6	45	А	4,5	11	5	п. Малокурильское, ощущ.
		12 49 16	43,7	149,3	30	Б		9	4	
		15 17 03	47,2	146,3	400	А			8	
		23 35 33	45,1	148,7	105–110	А			4	
	9	00 51 19	42,3	143,1	60	А		9,5	6	
		14 34 35	47,6	154,3	40	Б		9	2	
	10	00 29 26	42,5	146,0	40	Б		9,5	5	
		08 32 43	51,3	159,7	20	Б		10,5	1	
		08 34 47	51,4	159,6	20–40	Б		11	1	
		09 09 34	51,4	159,7	20	Б		11,5	1	
		12 38 57	42,9	145,5	40	А		9,5	5	
		17 43 16	43,3	146,7	40	А	4,0	10	5	
		18 32 16	43,3	146,1	40	Б		9,0	5	
	11	00 18 47	48,1	155,1	60	Б		10	2	
		03 30 53	51,0	156,5	140	А			1	
		05 16 35	43,2	146,4	40	А		10,5	5	
		12 03 54	50,2	157,1	100	Б			1	
		18 24 53	42,6	147,4	40	Б		10	5	
		20 02 15	42,5	147,4	40	Б		9,5	5	
		20 19 51	43,6	146,6	40	А		9,5	5	
	12	03 44 12	42,8	145,2	40	Б		9,5	5	
		07 44 01	46,1	151,0	60	А		9	3	
		07 56 16	42,7	146,8	20	А	5,0		5	
		14 28 06	50,7	154,0	200	А			1	
		17 27 33	43,1	146,8	30	А		9	5	
		20 57 22	43,4	146,5	40	А		9	5	
	13	02 24 22	47,4	154,3	40			9	2	
		13 39 39	43,4	147,6	50	А	5,0	11	5	
		14 00 06	42,6	146,9	30			9	5	
		22 11 12	42,5	146,8	30	Б		9	5	
	14	00 04 18	43,9	149,6	30	Б	4,5		4	
		00 59 26	44,3	149,6	30	Б	4,0		4	
		01 15 42	44,1	146,3	50–60	Б	4,5		5	

1	2	3	4	5	6	7	8	9	10	11
		03 15 41	44,0	146,2	50	А		10	5	
		08 20 13	43,5	146,2	70	Б		9,5	5	
		08 58 36	42,6	146,4	30	Б		10	5	
		10 07 11	43,1	146,7	40	Б		9,5	5	
	15	03 10 51	42,6	146,1	20	Б		9,5	5	
		03 27 45	47,2	152,7	60	А		9,5	3	
		03 33 22	43,5	146,7	40	А		9	5	
		06 33 06	42,9	146,8	40	А		9,5	5	
		06 36 43	45,3	150,2	40	А		10	3	
		07 08 23	50,4	157,0	40	Б		10	1	Южно-Курильск, 3 балла
		12 45 56	42,7	146,4	20			9	5	
		14 06 51	43,4	146,6	40	А	4,7		5	То же
		14 29 13	43,3	146,3	40	А		10,5	5	
		19 47 53	42,7	146,6	40	Б		9,5	5	
	16	04 13 23	42,3	146,3	40	А		10	5	
		08 03 56	42,3	145,9	40			9	6	
		20 39 16	43,1	147,0	40	А		9,5	5	
	17	09 02 50	43,3	145,8	50	А		9,5	5	
		09 35 10	43,0	146,9	40	А		10	5	
	18	00 02 56	42,4	145,8	40	Б		9,5	6	
		19 18 53	43,3	146,0	40	Б		10	5	
	19	01 27 38	49,7	156,3	40	Б		10	1	
		01 32 38	49,2	156,1	40	Б		9	1	
		02 21 15	43,6	146,9	50	А		11	5	Южно-Курильск, 4–5 баллов
		04 06 23	43,4	146,3	50	А		10,5	5	
		06 25 39	50,4	156,4	40	А		9,5	1	
		13 15 32	43,5	146,8	40	А		10,5	5	
		15 58 50	43,3	146,2	40	Б		9	5	
		16 30 13	43,1	147,7	40	А		10	5	
		18 21 05	48,6	154,9	40	А		9	2	
		23 54 25	42,6	147,4	40	А		10	5	
	20	11 31 32	45,9	153,6	30			9,5	3	
		13 19 36	43,1	146,4	40	Б		9	5	
		15 12 26	43,0	146,8	40	А		10	5	
		18 36 51	44,4	148,5	40	Б		9	4	
		18 49 10	42,8	146,6	40			9	6	
	20	22 26 13	48,8	150,2	330	Б			8	
		23 42 00	42,5	146,3	40	А	4,6	10	5	
	21	02 06 45	42,8	145,7	30–40	Б		9	5	
	22	19 27 52	46,4	152,5	30	Б		9,5	3	
		22 36 05	49,2	155,1	40			9	2	
	23	00 09 43	43,4	146,2	40			9	5	
		09 00 26	50,2	157,2	20	Б		10,5	1	
		10 11 14	50,2	157,2	20	Б		10	1	
		22 18 51	43,1	147,3	30	Б		9	5	
	24	14 50 22	43,2	146,4	25	А		11	5	
		23 56 57	48,3	154,2	70	Б		9,5	2	
	25	05 47 07	43,4	146,2	30	Б		9	5	
		09 53 57	43,0	146,0	30			9,5	5	
		10 15 47	46,1	151,0	110–120	А			3	
		11 36 48	49,9	156,7	10–50			9,5	1	
		19 17 16	46,5	154,0	50	Б		9,5	3	

1	2	3	4	5	6	7	8	9	10	11
		19 39 47	42,8	146,8	30			9	5	
		22 15 19	46,6	145,8	375	А			8	
	26	03 33 28	48,5	154,8	0–10			9,5	2	
	27	02 21 25	43,4	146,3	50	Б		9	5	
		07 28 42	43,4	146,3	30	А		10	5	
		19 20 56	43,7	146,6	70	А		10,5	5	
	28	04 20 44	43,2	145,8	60	Б		10	5	
'38		20 06 35	50,3	149,0	597	А	6,1		8	
	29	01 25 58	44,6	143,6	225	А			8	
		03 30 30	48,5	154,9	40			9	2	
		04 45 07	47,3	152,2	130	А			3	
		09 11 05	45,2	150,3	55	А		11,5	3	
		13 41 36	50,4	157,0	30–40			10	1	
		14 51 02	43,0	146,8	30	А	5,2		5	
	30	17 01 06	42,8	147,0	30			9	5	
		20 21 34	43,0	146,9	30	Б		9,5	5	
		22 02 12	42,6	146,2	30			9	5	
	31	00 33 30	43,7	147,0	40	Б		9	5	
					August					
	1	07 59 36	43,2	145,8	40			9	5	
		10 55 14	42,4	146,5	40			9	5	
		11 05 28	42,4	146,5	40			9,5	5	
		20 35 24	42,7	146,8	40			9	5	
	2	06 51 13	42,5	146,2	10	Б		10	5	
		14 41 30	42,2	146,6	40			9	5	
		17 03 26	43,5	146,8	40	А		9	5	
		19 45 01	43,3	146,2	40			9	5	
		22 55 00	43,5	140,0	225	А			7	
	3	06 26 27	42,6	145,9	40	А	5,0		5	
		06 42 41	50,3	157,5	40			9	1	
		13 42 28	43,4	146,5	50	А		9,5	5	
		16 53 18	48,6	154,7	40			9	2	
		19 06 35	50,1	157,2	40	Б		9,5	1	
		19 13 04	43,0	147,8	40	А	5,0		5	
		22 27 29	42,7	148,2	30	А		9,5	5	
	4	00 33 48	48,1	154,1	40			9	2	
		06 07 08	42,8	145,6	50	А		10,5	5	
		11 40 24	54,1	151,9	300	Б			8	
		19 09 23	46,9	153,2	40			9	3	
		22 24 58	46,5	154,1	40			9	2	
	5	07 36 16	43,3	146,6	40			9	5	
		08 46 12	43,3	146,5	40	Б		9	5	
		16 40 22	49,1	156,1	40			9	2	
		19 12 47	51,3	158,5	40	Б		10	1	
		21 39 04	48,6	154,8	40			9	2	
	6	03 22 55	43,9	148,5	40	Б		9,5	5	
		04 27 03	43,4	146,3	40			9	5	
		05 56 38	45,2	149,5	70	А		10,5	4	
		21 53 36	44,3	149,5	40	А		9,5	4	
		23 11 57	44,1	147,9	60	А	4,7		5	
	7	01 18 11	46,1	151,9	40	А		9,5	3	
		04 47 49	44,1	147,9	40	Б		9	5	
		23 16 56	44,4	147,8	120	А			5	
		23 54 21	45,0	148,8	40			9	4	

1	2	3	4	5	6	7	8	9	10	11
	8	04 48 02	42,9	145,8	40			9	5	
		10 50 59	42,3	145,9	40			9	6	
		13 42 10	52,3	152,4	400	Б			8	
		15 04 30	49,6	156,0	80	Б		9,5	1	
		21 40 58	43,4	146,3	40			9	5	
39	9	10 44 26	43,5	146,5	57	А	5,8	12	5	п. Малокурильское, 4–5 баллов; Южно-Курильск, 4 балла
		10 54 46	43,2	146,6	30	А		10,5	5	
	10	05 53 53	47,0	153,8	40			9	2	
		15 44 53	43,6	146,4	45	А	4,5	11	5	
		18 59 52	43,9	139,0	40	Б	4,8		7	
	11	00 22 10	46,7	152,9	30	Б		9	3	
		01 44 58	44,5	141,3	40	Б	4,0		7	
		04 46 02	43,5	146,9	40	А		9	5	
		07 34 34	42,6	148,0	40	Б		9	5	
		14 04 30	43,0	145,4	40	А	4,3	10	5	
		15 40 58	42,9	145,7	40	Б		9,5	5	
	12	02 55 18	42,8	148,3	40	Б		9	5	
		04 21 38	42,3	146,6	40			9	5	
	13	05 56 32	45,4	142,0	325	Б			8	
		11 40 32	43,4	146,7	30	А		10	5	
	14	01 42 32	50,1	157,2	40			10	1	
		01 42 32	50,4	157,1	0–10			10	1	
		10 05 40	47,3	146,9	380	А			8	
	15	02 14 32	44,1	148,6	40	А		9	4	
		05 46 22	45,6	150,8	150	Б			3	
		11 16 17	46,4	152,6	40	Б		9	3	
	16	21 35 50	42,0	145,6	40			9	6	
	17	00 53 12	46,4	152,9	30	А	4,3	10	3	
	18	02 00 52	50,3	157,4	40			9,5	1	
		04 39 50	42,9	146,8	40			9	5	
	19	06 31 11	49,3	156,6	40			9	1	
		10 51 43	43,6	146,8	40	А		9	5	
		13 09 24	42,8	146,7	40			9	5	
	20	02 15 04	48,7	155,3	40	Б		9	2	
		08 30 58	46,9	152,0	125	А			3	
		13 22 56	43,6	146,8	50	А		9	5	
	21	09 18 41	50,3	157,1	90	Б			1	
		22 37 03	43,3	146,9	40	Б		9	5	
	22	02 18 22	42,0	145,0	40			9	6	
		09 09 02	43,5	146,8	40	Б		9,5	5	
		14 35 25	42,1	144,8	40			9,5	6	
	23	06 35 20	43,8	145,9	80	Б		9	5	
	24	07 25 58	43,4	146,3	40	А		9,5	5	
		14 01 12	45,9	151,7	40	А	4,0	10	3	
		17 54 55	42,7	146,7	40	Б		9,5	5	
	25	15 15 43	43,4	146,8	45	А	4,2	11	5	
		19 25 21	43,0	147,1	40			9	5	
	26	01 16 01	43,3	146,5	40	Б		9	5	
		10 57 26	42,2	145,4	40			9	6	
	27	21 58 27	43,3	146,1	40	Б		9	5	
	28	20 15 10	45,6	151,9	40			9	3	

1	2	3	4	5	6	7	8	9	10	11
	30	01 14 12	43,8	147,9	40	А		9,5	5	
		12 32 27	43,3	146,5	40	А		9	5	
	31	00 17 28	43,4	146,4	40	Б		9	5	
				September						
	1	13 38 42	43,2	144,0	150	А			6	
		23 08 28	42,1	146,7	40	Б		9,5	5	
	2	00 23 03	43,7	147,9	40	Б		9	5	
		15 52 06	42,7	143,4	120–125	А			6	
		22 41 36	51,1	157,7	20	Б		9	1	
	3	00 32 17	43,1	146,4	40	Б		9	5	
		12 15 57	50,2	156,9	40	Б		9	1	
		16 25 43	44,0	146,2	85	А			5	
		17 03 56	43,2	145,7	50	Б		9	5	
	5	09 08 16	44,0	148,4	45	А	4,2	10	5	
		09 22 16	50,5	157,5				9	1	
		10 50 04	52,0	161,0	5–10	Б		10	1	
		17 26 38	43,5	148,7	40	Б		9,5	5	
	6	01 31 43	42,6	145,5	40	А		10	6	
		03 41 40	51,4	160,3	40			9,5	1	
		11 04 20	43,0	141,7	140	А			6	
	8	02 48 18	43,3	146,5	40	Б		9	5	
		05 22 24	43,1	145,1	40			9	6	
		22 17 25	49,8	157,2	40			9,5	1	
		22 49 07	42,5	144,5	40	Б		10	6	
40	10	07 43 33	42,4	131,1	573	А	6,5		7	
	12	20 12 25	45,8	149,6	160	А			3	
		21 03 54	43,6	146,0	110	Б			5	
	13	07 20 45	46,1	144,7	325	А			8	
		08 15 26	43,5	147,6	40	Б		9	5	
		08 55 50	44,9	150,3	40	Б		9	4	
		14 14 48	49,6	150,5	320	Б			8	
		14 44 19	50,3	157,0	40	Б		9	1	
		17 19 52	43,0	145,4	70	А		10	6	
	14	04 36 51	43,3	146,5	40	Б		9	5	
		21 15 29	50,9	157,7	40	Б		10	1	Северо-Курильск, 2–3 балла
	15	01 24 15	43,3	146,5	40	Б		9	5	
		03 09 58	42,4	146,2	40			9	5	
		11 32 48	42,9	147,6	40			9	5	
		15 36 56	42,5	146,7	40	А		10	5	
		15 59 13	43,2	143,8	110	А			6	
	16	03 15 28	43,3	146,4	40	А		9	5	
		17 37 41	48,3	151,9	150				2	
		21 10 20	45,4	152,6	10			9	3	
	17	00 10 14	51,6	158,7	40			10	1	
		06 06 58	45,3	150,2	40			9	3	
		17 55 30	49,7	156,8	40			9	1	
	18	05 42 43	43,4	146,3	40	Б		9	5	
	19	23 48 28	50,6	157,0	10–40	Б		9,5	1	о-в Шумшу, 2–3 балла
	22	12 51 49	50,6	158,1	40			9	1	
		18 05 25	43,3	146,3	40	Б		9	5	
		19 41 11	50,2	157,1	40			9	1	

1	2	3	4	5	6	7	8	9	10	11
	23	06 19 44	51,6	158,4	20–30	Б		9	1	
		07 26 10	43,2	146,5	40	А		10	5	
		14 40 46	50,6	157,1	40	Б		9,5	1	
		19 14 02	51,2	157,7	130	Б			1	
		19 52 57	44,2	149,1	40			9	4	
	24	05 07 50	43,1	146,0	40			9,5	5	
		13 41 21	43,4	146,8	40	А	4,3	10,5	5	Южно-Курильск, 3 балла
	26	12 21 46	50,4	157,0				9,5	1	
	27	03 19 29	44,0	147,1	45	Б		9	5	
		10 10 25	48,9	156,8	40			9	1	
		12 37 00	49,1	156,4	40	Б		10	1	
		17 01 49	50,2	157,8	40			9,6	1	
	28	04 40 37	43,1	145,0	70	А		10,5	6	
	29	00 44 02	42,0	131,0	600	А			7	
		08 51 28	49,7	156,6				9	1	
		20 27 55	51,7	160,8	30	Б.		10	1	

October

1	2	3	4	5	6	7	8	9	10	11
	1	07 26 21	51,0	158,2	40–80	Б		9	1	
		13 41 50	49,7	155,8	40	Б		9,5	2	
		15 52 05	43,3	145,8	40	А		9,5	5	
	2	04 52 55	49,5	156,7	40	Б		10	1	
		07 04 42	48,7	154,7	40	Б		9,5	2	
		08 29 37	43,1	145,5	50	А		10,5	5	
		19 28 11	43,3	146,9	45	А		10,5	5	
	3	05 37 03	43,3	145,9	40			9	5	
41		10 35 51	45,4	152,0	30	А	5,4	11,5	3	
		12 54 55	45,7	151,7	50	А	4,6		3	
	4	03 50 17	44,6	141,0	250	А			7	
		13 38 47	45,8	151,8	50	А	4,7	10,5	3	
		14 15 18	45,5	152,1	40	Б		9,5	3	
		16 36 44	46,6	153,9	40			9	3	
		18 57 02	45,6	151,9	30	А	4,2	9,5	3	
	5	21 20 24	43,3	146,6	30	А	4,0	9,5	5	
	6	15 38 55	42,3	146,9	40			9,5	6	
		17 12 02	50,4	156,8	60	А		10,5	1	
	7	02 02 23	47,1	152,4	95	А			3	
		04 54 54	46,9	154,6	30	А	4,1	10	2	
		09 27 02	42,5	146,5	15	А	5,2		5	
		13 51 54	49,6	156,4	40	Б		9,5	1	
		15 07 01	50,5	157,1	50	А		10	1	
		18 47 22	50,5	157,1	40	А		10	1	
	8	04 57 21	47,4	152,7	125	Б			2	
		05 26 25	45,6	152,0	20	Б	4,0	10	3	
		06 21 03	50,0	157,0	40	Б		9,5	1	
		07 03 26	42,1	143,0	40	Б		9,5	6	
		07 48 34	50,6	156,2	90	А			1	
		08 26 21	45,8	151,8	55	Б	4,4		3	
		16 28 47	46,9	153,0	40	А		9,5	3	
		18 55 27	44,4	148,1	40	А		10	4	
	9	07 47 17	43,4	146,9	40	А	4,5	11	5	
		13 03 45	42,5	146,1	20	Б	4,3	10,5	5	
		18 07 15	51,1	160,4	10–40	Б		11	1	

1	2	3	4	5	6	7	8	9	10	11
	10	16 58 52	46,0	151,6	30	А		10	3	
	11	14 55 54	49,1	155,4	85	А		11	2	
	12	03 03 10	50,2	161,1	40	Б		10	1	
	13	08 54 08	42,8	145,8	50			9,5	5	
		10 00 10	42,4	146,0	45	А		10,5	5	
	13	15 41 12	42,3	146,3	40			9,5	5	
	14	21 20 38	44,5	149,4	30–40	Б		9,5	4	
	15	03 21 51	45,2	151,7	30	А	4,1	10	3	
		16 06 17	42,8	144,9	30	Б		9,5	6	
		20 18 33	44,4	148,7	40	А		10	4	
	16	12 11 17	44,6	148,5	40			9	4	
		22 14 43	42,4	146,4	40	Б	4,2	10,5	6	
	17	01 54 00	47,4	153,2	30	Б		10	2	
		08 51 08	49,2	156,3	30	Б		9,5	1	
		13 26 07	50,5	157,5	30	Б		10	1	
	18	08 50 28	50,2	157,0	40–50	Б		9,5	1	
	19	02 35 48	42,9	145,7	40			9,5	5	
		21 04 06	44,1	149,1	20	А	4,5	10,5	4	
		23 40 10	44,2	149,1	60	А	4,7	10,5	4	
	20	00 24 36	44,2	149,1	30	А	4,5	10,5	4	
		15 44 32	43,3	146,9	30	А		9	5	
		18 04 10	49,7	156,3	60	Б		9,5	1	
	22	00 27 33	45,3	150,4	40	Б		9,5	3	о-в Уруп, 2–3 балла
		22 09 20	50,0	157,1	40	Б		9,5	1	
	23	05 09 15	51,6	159,3	10–20	Б		11	1	
		07 45 36	42,8	146,5	40			9	5	
		08 44 41	44,5	149,6	40	Б		9,5	4	
		11 58 05	45,6	143,3	320	А			8	
	24	04 27 56	48,1	146,5	490	А			8	
		05 49 35	43,6	146,7	45	А		9,5	5	
		11 28 35	48,0	146,6	500	А	5,2		8	
	25	08 43 19	43,6	146,6	40	А		10	5	
	26	10 09 11	45,2	150,2	50	А	4,5		3	
	28	07 16 45	50,5	157,0	10–40	Б		9,5	1	
		12 41 30	50,3	157,1	10–40	Б		9,5	1	
		14 01 57	44,2	147,8	90	А			5	
	29	05 49 34	49,6	156,2	40	Б		10	1	
		14 45 10	44,5	149,7	30	А	4,3	10	4	
	31	23 07 01	42,8	145,3	25	А	4,4	10,5	6	
					November					
	1	17 51 48	51,1	160,3	0–10			10	1	
	2	00 32 31	50,2	157,0	30	Б		10	1	
		22 18 46	45,1	149,5	40			9,5	4	
		23 12 04	51,2	157,5	40			9	1	
	3	01 19 27	46,4	153,3	40			9	3	
		10 18 59	50,4	157,0	40	Б		9,5	1	
		14 59 31	44,6	149,4	40	Б		9	4	
		16 36 44	44,9	149,5	40	Б		9	4	
	4	22 44 28	45,1	141.8	250	Б			6	
	5	10 55 02	48.9	155,7	40	Б		10	2	
		19 10 22	43,1	146,8	30	Б		9,5	5	
		20 00 40	42,7	146,7	50	А	4,5	10	5	

1	2	3	4	5	6	7	8	9	10	11
	6	00 09 30	45,8	151,4	40	Б		9	3	
		00 21 59	47,1	153,7	40			9	2	
		10 23 33	44,1	148,0	70	А		10,5	5	
		10 54 39	42,6	144,8	100	А			6	
		22 55 30	49,0	155,6				9	2	
	7	13 44 37	50,1	157,3	30	А		11	1	
		14 09 08	42,3	146,1	30			9,5	6	
		14 57 12	43,0	145,4	70	А		10	6	
42	8	08 59 11	49,9	156,4	55	А	6,3		1	о-в Шумшу, 6 баллов; Северо-Курильск, 5–6 баллов; Паужетка, 3 балла; о-в Матуа, 2–3 балла
43		09 02 41	49,7	156,8	30	Б		12	1	
		09 09 38	50,0	157,0	30			9,5	1	
		10 54 33	50,0	156,9	30			9,5–10	1	
		13 43 03	49,9	156,2	30			9,5	1	
		16 53 02	49,8	156,9	30			9,5	1	
		18 56 40	50,4	157,0	40			9,5	1	
	9	05 33 22	43,7	147,6	65	Б		9,5	5	
		05 58 22	51,0	158,0	40	Б		10,5	1	
		12 27 39	47,5	154,5	40	А		9,5	2	
44	11	02 43 08	49,9	156,5	65	А	6,0		1	м. Васильева, 4–5 баллов; Северо-Курильск, 4–5 баллов; о-в Матуа, 4–5 баллов; о-в Шумшу, 3–4 балла
		02 50 33	49,9	156,6	40	А		10,5	1	
		03 33 45	49,9	156,7	30	Б		10,5	1	м. Васильева, 3 балла
		15 29 30	43,3	146,2	40	Б		9,5	5	
		16 25 12	44,4	146,8	135	А			5	
		18 23 49	51,9	157,9	140–150	Б			1	
	12	09 38 52	42,3	142,6	50	А		10	6	
	13	01 32 20	43,5	146,7	40	А		9,5	5	
45		02 47 16	49,6	151,5	325	А	5,7		8	
		10 34 16	43,5	146,5	40	А		9	5	
		20 12 36	42,9	146,0	40	А		9,5	5	
		22 26 56	45,4	150,1	40	А		9,5	3	
		23 32 28	45,4	150,7	30	А		9	3	
	14	22 56 21	44,0	147,6	110	Б			5	
	15	22 31 56	45,5	142,5	310	А			8	
	16	03 59 32	43,3	146,3	40	А		9,5	5	
	17	00 26 27	43,0	147,5	30	А	5,0	11,5	5	
		21 24 32	42,4	141,6	120	А			6	
		22 09 42	50,9	157,4	80	А		10,5	1	
		23 02 18	42,7	147,4	40			9,5	5	
		23 17 18	50,4	157,4	70	А		9,5	1	

1	2	3	4	5	6	7	8	9	10	11
	18	08 14 26	50,0	156,8	0–40			9,5	1	
		12 07 37	44,3	149,1	50	А	4,7	11	4	п. Рейдово, 5 баллов
	20	23 36 30	42,0	142,6	50			9,5	6	
	21	18 10 05	42,3	146.8	50	Б		10	5	
46	21	21 05 23	46,1	151,6	90	А	6,2		3	о-в Уруп, 3–4 балла; о-в Симушир, 2–3 балла; о-в Матуа, 2 балла
		23 25 22	50,0	156,8	20	А		10,5	1	
		23 55 34	43,3	146,5	40	Б		9	5	
	22	01 21 06	46,6	153,0	40			9,5	3	
		03 12 16	44,2	148,6	30	Б		9	5	
		08 37 15	42,3	146,9	40			10	5	
		10 19 35	43,0	145,7	20			9	5	
		22 52 37	44,2	147,9	30	Б		9	5	
	23	07 27 28	50,4	157,0				9,5	1	
		16 10 18	43,4	146,2	50	Б		9,5	5	
	24	02 53 58	43,2	145,6	40			9	5	
		07 52 18	45,1	149,5	40	А		9	4	
		23 42 06	47,0	154,3	40			9	2	
	25	09 52 30	43,6	146,9	50	А		9,5	5	
	26	22 50 20	51,3	157,0	0–10			10	1	
	27	06 19 23	42,7	146,5	20–30	А		10,5	5	
	28	05 40 38	43,3	147,9	20	А		10	5	
		09 38 21	43,4	146,3	60	А		9	5	
		12 12 24	43,4	147,0	50	А		9	5	
		22 11 07	50,3	157,0				9,5	1	
	29	09 52 10	44,5	147,5	130				5	
		17 19 35	42,9	145,5	50	А		10,5	5	
		17 59 20	53,2	153,5	490–500	А	5,6		8	
		20 46 33	44,3	148,2	40	Б		9	4	
	30	17 01 23	43,5	146,2	50	А		10,5	5	
					December					
	1	01 59 18	50,1	157,1	30	А		10	1	
47		10 38 53	43,1	146,3	40	А	5,5	12	5	
		22 26 11	43,3	146,8	40	Б		9,5	5	
48		23 16 56	43,1	147,1	30	А	6,2		5	
49		23 18 06	43,3	146,7	55	А	6,5		5	Южно-Курильск, 4–5 баллов
		23 36 07	43,0	147,0	40			9,5	5	
	2	00 45 36	42,9	147,0	35	А		10,5	5	
		01 32 27	43,1	147,1	40	А	4,0	10	5	
		01 39 03	43,0	146,9	40			9	5	
		02 16 12	42,9	147,1	40	Б		9,5	5	
		02 26 51	42,9	147,1	40	Б		10	5	
		03 52 37	43,0	147,2	40			9,5	5	
		07 58 44	42,9	146,9	40			9	5	
		10 17 11	43,3	147,7	40	А	4,5	10	5	
		11 28 39	43,1	147,2	40			9	5	
		19 11 52	42,0	147,2	40			9	5	
		23 45 05	42,7	146,7	40	Б		9,5	5	

1	2	3	4	5	6	7	8	9	10	11
	3	01 42 02	45,2	150,5	40	Б		9	3	
		10 33 41	50,2	158,9	10–40			9	1	
		12 53 39	44,1	151,8	40	Б		9	3	
	4	01 26 03	43,0	147,2	30	А	4,5	10,5	5	
		15 26 01	51,3	158,4	50	А		10	1	
	5	19 09 37	42,2	145,3	40			10	6	
	6	05 17 54	43,3	146,2	50	А		10	5	
		09 16 23	43,5	146,3	40	А		9	5	
	7	08 57 37	43,8	147,2	60	А		9	5	
		16 19 01	43,2	146,0	40	А		9,5	5	
	8	13 54 46	44,0	147,4	50	А		9,5	5	
	9	07 27 49	50,2	157,2	40	А		11	1	Северо-Курильск, подземные толчки; о-в Шумшу, 2–3 балла
		19 09 25	43,0	148,0	40	А		10	5	
	10	20 08 27	49,6	156,5	30	Б		9,5	1	
	11	07 59 30	47,3	154,8				9	2	
		20 43 32	49,2	155,7				9	2	
	12	07 26 02	45,9	152,1				9	3	
		11 51 00	44,7	150,6				9	4	
	13	05 38 06	44,2	148,7				9	4	
		09 42 41	49,1	156,2				9	2	
		13 14 08	49,9	157,7	0–50			11	1	
		15 29 23	42,6	146,8	50	А		9,5	5	
	15	18 07 06	45,3	151,5	40	А	4,1	10	3	
		19 45 58	50,4	156,8	40	Б		11	1	Северо-Курильск, 1–2 балла
	16	21 17 09	50,4	157,6	40	Б		10	1	
		23 10 46	47,9	149,1	450	А			8	
50	17	21 54 07	48,4	154,7	50	А	5,3	12,5	2	о-в Матуа, 6–7 баллов
	19	14 18 50	46,4	153,6				9,5	3	
	20	05 06 31	43,4	146,9	50	А		9,5	5	
		08 23 10	50,7	157,4	10	Б		9,5	1	
		11 10 48	43,2	149,0	20–30	А		10,5	5	
	20	12 33 29	44,6	148,4	70	А		10,5	4	
	21	15 11 54	50,4	157,1				9,5	1	
		17 20 30	46,3	153,6				9	3	
		21 15 35	47,0	153,0	80	Б		9	3	
	22	09 59 50	53,0	160,0	40–50	Б		9,5	1	
	23	17 06 43	49,9	156,8				9,5	1	
	24	23 38 25	42,6	146,0	40	А	4,7		5	
	26	12 53 00	49,5	155,9	50	А	4,5	11,5	1	
		22 28 09	43,4	146,2				9	5	
	29	14 20 30	43,4	146,4				9	5	
		21 06 56	43,5	146,3	60	Б		9,5	5	
	31	05 48 12	51,6	160,1	0–10			10	1	
		05 52 50	42,8	147,0				9	5	
		08 11 36	42,7	147,0				9	5	

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EARTHQUAKES AND TSUNAMI ON 28 FEBRUARY 1973

L. S. Oskorbin, V. M. Zobin, L. N. Poplavskaya, M. I. Rudik,
N. A. Shchetnikov, A. N. Boychuk, N. N. Leonov, I. G. Simbireva,
T. N. Khantayeva, L. S. Shumilina

On 28 February 1973 at 17:38 Sakhalin time, 35 kilometers east of the city of Severo-Kuril'sk, an earthquake was registered with M=7.5, which caused vibrations of the soil of up to 7 points [1]. The seismic jolt, the hypocenter of which lay at a depth of H=70 km beneath the ocean bottom, evoked a tsunami wave, which reached the coastal area of the Kuril Islands at a height of 1.5 meters [2].

The macroseismic information, as well as the data on the tsunami in the islands of the Kuril ridge, were gathered by associates of the Sakhalin Complex Scientific Research Institute of the Far East Scientific Center of the USSR Academy of Sciences, and on Kamchatka Peninsula and the Komandorsky Islands--by associates of the Institute of Volcanology (IV) of the Far East Scientific Center of the USSR Academy of Sciences and the Pacific Ocean Seismological Expedition (TSE) of the Institute of Physics of the Earth of the USSR Academy of Sciences.

The macroseismic material was summarized by L. S. Oskorbin, N. N. Leonov (Sakhalin Complex Scientific Research Institute) and L. S. Shumilina (TSE). The mechanisms of the focal points of the foreshocks, aftershocks and the main jolt were determined by V. M. Zonin (IV) and M. I. Rudik (SakhKNII).

The instrument data on the earthquake on 28 February and its repeat jolts were summarized by A. N. Boychuk, L. N. Poplavska, I. G. Simbireva and T. N. Khantayeva.

Instrument Data

The epicenter of the main jolt and the earthquakes following it with M-4.5 were determined on a Minsk-22 computer by means of the EPITsENTR program [3]. The focal depths of the earthquakes with M=5 as a rule could be calculated according to the difference in sP-P and pP-P, taken from the seismogram of the Far East seismological stations or taken from the bulletins of the teleseismological stations.

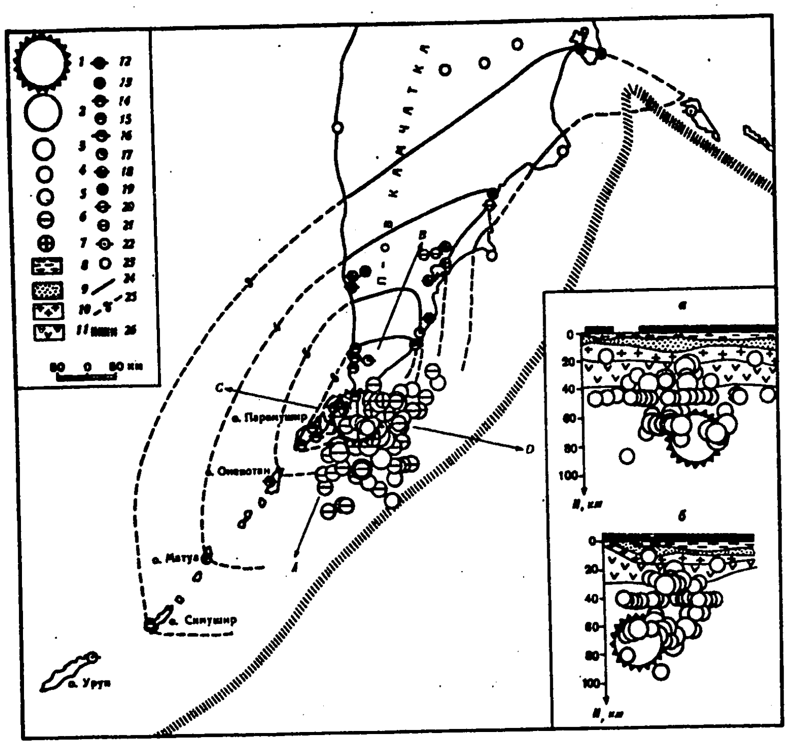

Figure 1. Diagram-Map of the Earthquake on 28 February and Projection of the Main Jolt and Aftershocks onto Vertical Planes Passing Along the lines AB 9a) and CD(b).

Magnitude and energy class: 1--$7.5 \geqslant M \geqslant 6.5$; 2--$6.5 > M \geqslant 5.25$; $11 < K < 14$; 3--$4.25 \leqslant M \leqslant 5.25$; $9 < K < 11$; 4--$K=9$. Focal depth: 5--$0 \leqslant H \leqslant 30$ km; 6--$30 < H \leqslant 60$ km; 7--$60 < H \leqslant 90$ km; 8--water; 9--sediments (average rate of P-wave less than 3.5 km/sec); 10--"granite" stratum (rate of P-waves 5.2-6.4 km/sec); 11--"basalt" stratum (rate of P-waves 6.4-7.0 km/sec). Macroseismic effect (points): 12--7-8; 13--7; 14--6-7; 15--6; 16--5-6; 17--5; 18--4-5; 19--4; 20--3-4; 21--3; 22--2-3; 23--not felt; 24--certain isoseismal line of the given point; 25--uncertain isoseismal line of the given point; 26--axis of deep-sea Kuril-Kamchatka trench.

The spatial coordinates of the weaker earthquakes were determined by the method of cross bearings or isochrones. The energy estimate of the earthquakes was made by the standard method.

The preceding articles contain the principal data on the earthquake on 28 February and its repeat jolts. This work has only a map of their spatial distribution (Fig. 1). It can be seen from the map that the area of the aftershocks of the earthquake on 28 February extended along the strike of the structures of the island arc, and the focal points of the main jolt and the deepest subsequent earthquakes were shifted in relation to the center of this area toward the main shelf and were distributed parallel to the strike of Paramushir Island. It is also interesting to note that for the sequence of aftershocks studied the maximum magnitudes of those observed (6-6.25) corresponded to the greatest depths of the hypocenters (50-70 km). The statistics on the strong (M=5.5) earthquakes that interested us for the area according to the data for 1911-1972 indicate that the averages of the depths of the hypocenters observed had values of H=65 km, and the nature of the relation between the focal depth and the magnitude was analogous to that observed in the sequence of aftershocks of the main jolt.

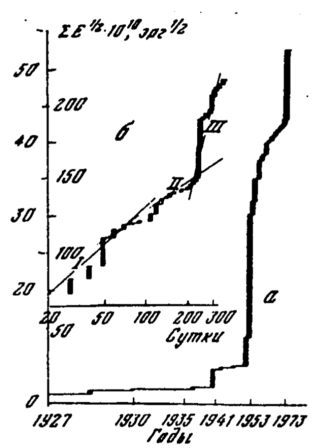

Figure 2. Characteristics of the Energy Release of Elastic Deformations for Earthquakes with M$\geqslant$5.5 in the Region of Paramushir Island in 1927-1973 (a) and in the Series of Aftershocks of the Earthquake on 28 February 1973--From 28 February 1973 to 28 February 1974 (b). I-III--periods of elastic deformation release.

The frequency graph of the aftershocks

lgN=6.00--0.98 M ($\pm$0.23),

where N is the number of jolts of a given magnitude M, and M varied from 4.5 to 6.25, makes it possible to establish the fact that in this sequence jolts with M$\geqslant$4.25 were fully established, and with M=4--not over 50 percent of their number.

The nature of the relation of the number of repeat jolts to the time that passed from the moment of occurrence of the main shock:

$$N = 52t^{-1,3}\ (\pm 1,7),$$

makes it possible to draw the conclusion that the sequence of earthquakes being studied were subject to the conformances to principle observed for similar aggregates of earthquakes [4].

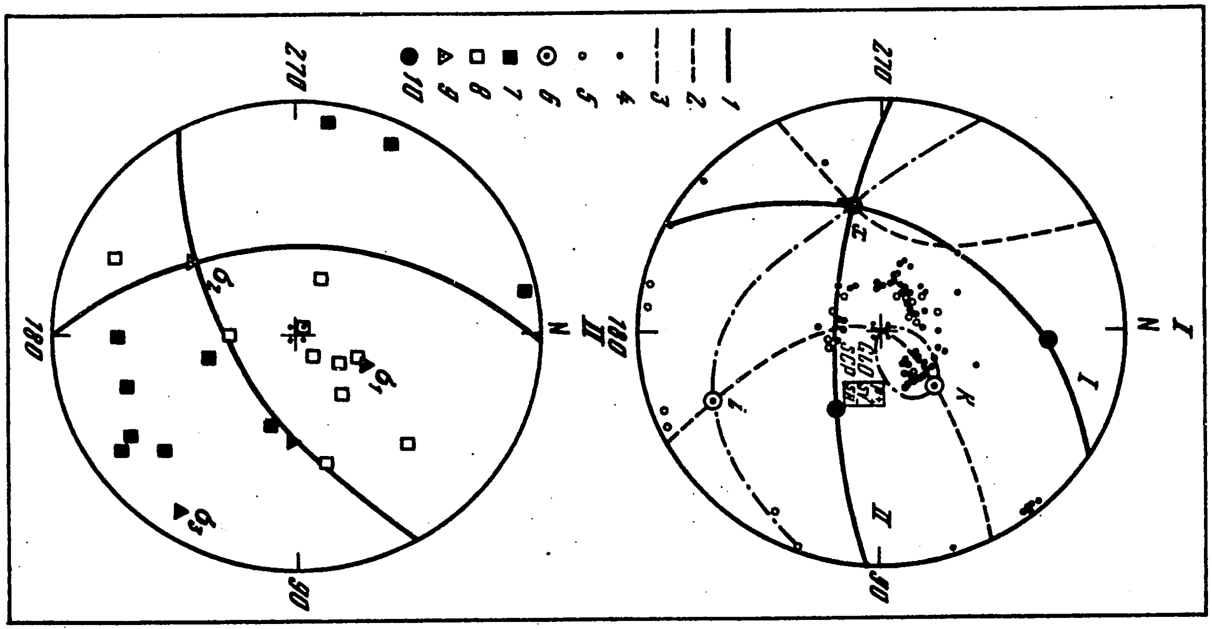

Figure 3. Mechanism of the Focus of the Main Jolt on 28 February 1973 (I) and Tensor of Main Stresses of the Focal Zone (II) According to V. M. Zobin.

Nodal lines: 1--P-waves, 2--SV-waves, 3--SH-waves. The nature of the waves being recorded: 4--compression, 5--tension, 6--main axes of stresses (i--compression, K--tension, x--interstitial). The projections of the points of emergence of the axes of main stresses, in effect at the focal points of the aftershocks with M $\geqslant$5 and of the main jolt: 7--compression, 8--tension, 9--main stresses of the tensor of the focal zone (σ_1, σ_2, σ_3); 10--emergence of axes of ordinates (x, y, z).

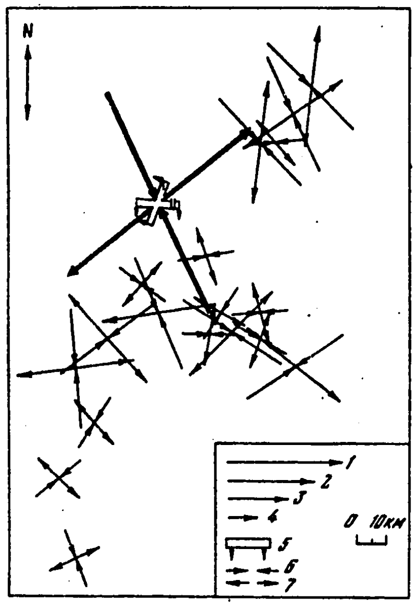

Figure 4. Strike Direction of Fault Planes of Main Jolt and Orientation of Axes of Main Stresses at Focal Points of Series of Aftershocks

Classification by magnitude: 1--M $\geqslant$ 7.5; 2--7.5 $>$ M $\geqslant$ 6.5; 3--6.5 $>$ M $\geqslant$ 5.25; 4--M 5; 5--strike and dip of possible fault planes I and II. Orientation of axes of main stresses: 6--compression; 7--tension.

The energy release of the elastic deformations over a period of 30 days is characterized by the function

$$\Sigma E^{1/2} = A + B \lg t,$$

where E is the energy of the individual jolt; t--the time; A and B--the parameters which in the period from 28 February to 12 March 1973 assume the values A=7.86 and B=7.03. After the earthquake on 12 March at 11:19, the rate of release of the elastic deformations rose sharply and the parameters of the function (1) assumed the following values: A=6.08 and B=11.8.

A comparison of the characteristics of the release of the elastic deformations and series of aftershocks during the period from 28 February 1973 to 28 February 1974 with the detailed description obtained from the data on strong (M $\geqslant$ 5.5) earthquakes in the region being described in 1927-1973 (Fig. 2) reveals their similarity. This apparently attests to the stability of the seismotectonic processes taking place in this region.

Table 1. Mechanisms of Focus of Earthquake on 28 February 1973,

Дата (1)	Время в очаге, час, мин, сек (2)	Координаты очага (3)			Магнитуда, M, m_{PV} (4)	Плоскость I (5)			
		φ°N	λ°E	H, км		Азимут падения (6)	Угол падения (7)	Компоненты подвижки (8)	
								по простиранию (9)	по падению (10)
Foreshocks									
27.I	04 04 42	50,3	156,8	60	4,6	314	63	0,755	+0,656
10.II	16 55 38	49,7	156,1	70	5,0	185	65	0,682	+0,731
26.II	08 16 58	49,2	156,0	40	4,4	284	62	0,874	−0,485
Main Jolt									
28.II	06 37 56	50,5	156,3	70	7,5	294	50	0,888	+0,469
						302*	40	0,842	+0,530
Aftershocks									
28.II	06 55 40	50,1	157,1	55	5,0	294	63	0,707	+0,707
28.II	10 18 42	50,1	156,9	60	5,0	86	62	0,777	−0,629
28.II	11 32 44	50,1	156,9	60	5,3	154	70	0,743	+0,669
1.III	02 19 06	50,0	157,1	45	5,0	153	71	0,766	+0,643
						302*	56	0,642	+0,766
3.III	02 42 11	50,2	156,4	65	5,0	294	62	0,777	+0,629
						304*	70	0,940	+0,342
12.III	11 14 25	50,1	156,5	55	5,7	318	52	0,391	+0,921
						152*	64	0,530	+0,848
12.III	19 39 22	50,7	157,1	70	6,0	149	62	0,359	+0,934
						142	50	0,087	+0,996
21.III	02 24 21	50,7	157,2	65	5,0	98	62	0,293	+0,956
						160*	60	0,454	+0,891
25.III	08 56 16	49,9	157,3	25−30	5,3	105	60	0,500	−0,866
						340	52	0,883	−0,466
31.III	20 45 32	50,1	156,9	50	5,0	59	70	0,707	+0,707
12.IV	13 49 20	50,3	157,3	65	6,0	181	60	0,615	+0,788
						282*	54	0,208	+0,978
12.IV	12 17 18	49,9	156,0	65	5,2	53	70	0,829	−0,559
						277*	40	0,951	−0,309
17.IV	22 09 51	50,9	157,4	60	5,6	148	64	0,342	+0,939
						278	40	0,743	+0,669
8.VI	08 59 14	49,8	156,1	60	6,3	153	62	0,358	+0,933
11.XI	02 43 08	50,0	156,2	60	6,0	245	48	0,242	+0,970
26.XII	12 53 00	49,5	155,9	50	4,5	272	80	0,848	+0,529

Key:

1. Date
2. Time at focus, hrs, mins, sec,
3. Coordinates of focus
4. Magnitude
5. Plane I
6. Dip azimuth
7. Dip angle
8. Components of shift
9. Along strike
10. Along dip

Note. The first line shows the solutions of M. I. Rudik, and the second--the solution of V. M. Zobin. Solutions found from drawing on the features in the S-wave are marked with asterisks.

and Its Foreshocks and Aftershocks (Conclusion)

(11) Плоскость II				(12) Напряжение					
(6) Азимут падения	(7) Угол падения	(8) Компоненты подвижки		(13) сжатия		(14) промежуточное		(15) растяжения	
		(9) по простиранию	(11) по падению	A_z°	e°	A_z°	e°	A_z°	e°

Key:

11. Plane II
12. Stress
13. Compression
14. Interstitial
15. Tension

				Foreshocks					
66	54	0,829	+0,559	282	04	17	42	186	46
70	50	0,819	+0,574	214	08	116	88	316	50
30	66	0,848	−0,529	157	40	335	52	67	01
				Main Jolt					
187	70	0,755	+0,669	154	11	257	43	54	46
186	68	0,616	+0,788	158	15	262	34	50	54
				Aftershocks					
50	50	0,809	+0,587	265	07	01	38	165	50
335	56	0,838	−0,545	213	46	25	43	118	04
262	52	0,898	+0,438	120	12	224	45	21	43
258	52	0,927	+0,375	119	12	223	46	17	40
64	50	0,707	+0,707	274	05	7	32	178	57
184	56	0,809	+0,587	306	07	235	43	41	29
205	70	0,927	+0,375	345	02	252	60	74	30
173	44	0,423	+0,906	335	04	243	18	80	72
30	40	0,743	+0,669	175	15	80	28	290	60
290	35	0,559	+0,829	134	16	230	19	08	65
322	40	0,070	+0,998	142	05	50	02	308	86
245	34	0,500	+0,866	86	15	180	15	316	68
295	40	0,642	+0,766	142	10	235	25	30	65
334	42	0,642	−0,766	237	62	32	26	127	10
235	68	0,766	−0,642	100	45	300	46	200	10
309	50	0,898	+0,438	89	13	347	42	191	44
306	46	0,719	+0,695	156	06	250	31	55	58
122	40	0,276	+0,961	160	47	296	40	42	22
310	58	0,927	−0,374	175	38	346	56	82	04
15	76	0,642	−0,766	160	47	296	40	42	22
289	32	0,573	+0,819	133	16	229	18	18	66
157	66	0,530	+0,848	133	13	232	28	18	58
296	36	0,545	+0,838	137	15	232	19	13	68
44	44	0,275	+0,961	235	02	325	10	136	30
08	54	0,974	+0,225	232	15	347	52	133	31

Table 2. Macroseismic Data on Earthquake on 28 February 1973 at Distances up to 150 km.

Region	Epicentral distance, km	Bldg type	Degree of damage on MSK-64* scale			Sensation	Intensity by MSK-64 scale	Comments
			d_1	d_2	d_3			
Shumush I:								
Baykovo	40	A		5		Fright (50)	6-7	Snow bench slides
		B	100	50				
Kozyrevskiy	40	C		+			7	Tsunami to 1.5 m
Babushkino	50			+			5-6	
Paramushir I.:								
Severo-Kurilsk	40	A	100		+	Fright(100)	7	Low rumble
		B			+			Tsunami to 1.5 m
Shelikhovo	40	C		+		Fright(100) Awoken(50)	6-7	
Vasil'yeva C.	80						5	
Onekotan I.	130	B				Awoken(100)	4-5	
Kamchatka P.								
Lopatka C.	76		+				6	
Shumnyy	120	C	100			Fright(100) Awoken(100)	6	
Ozernovskiy	128	B	100			Fright(100)	6-7	
		C			5	Awoken(100)		
Pauzhetka	140					Fright(75) Awoken(100)	5-6	Underground rumble
Zaporozh'ye	150		100			Noted (100)	6	

* See in book, "Seysmicheskoye rayonirovaniye SSSR" [Seismic Regionalization of the USSR], Moscow, Nauka, 1968.

** The percentage of inhabitants who noted this indication is indicated in parentheses.
The + sign designates a rise in the tsunami wave.

Possible Mechanism of Focus

Preliminary data on the dynamic parameters of the focal points obtained by V. M. Zobin and M. I. Rudik are given in Table 1.

The solutions were obtained by using the methodology of A. V. Vvedenska, as a rule, on the basis of the information only concerning the features of the onset of the P-waves.

To construct the focal mechanism of the main jolt and the six strongest ($M \geqslant 5$) aftershocks, V. M. Zobin was able to draw on information on the signs of the arrival of the SV- and SH-waves (one to two signs for each solution). Taking this fact into consideration, when figures 3 and 4 were plotted, preference was given to these solutions, and in the other cases the solutions of M. I. Rudik are given, which are unique.

Figure 3 (1) depicts the diagram on which were assembled the data on the arrival signs of the P-waves, observed for the main jolt. The plottings showed that the mechanism of the focus of the earthquake on 38 February may be interpreted as a strike-slip thrust fault along the quite steeply dipping fault planes.

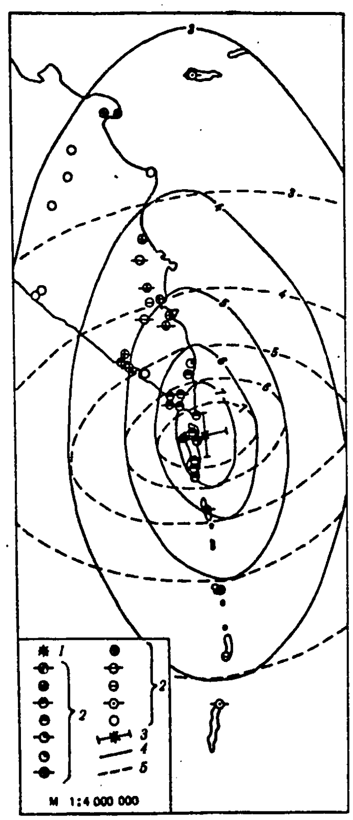

Figure 5. Theoretical Isoseismal Lines of the Macroseismic Effect of the Earthquake on 28 February 1973

1--instrument epicenter; 2--intensity corresponds to designations in Fig 1; 3--length of the fault, in km; 4--theoretical isoseismal lines, directed along plane I; 5--same, in direction of fault plane II

Table 3. Macroseismic Data on Earthquake on 28 February 1973 at Distances of Over 200 km

Region	Epicentral distance, km	Perception	Intensity on MSK-64 scale	Comments
Kamchatka P: Oktyabr'skiy	216	Noted (100)	4-5	
Bol'sheretskiy beacon	240	" (100)	4-5	
Kruglyy beacon	240	" (100)	4-5	
Ust'-Bol'sheretsk	280	weak (100)	4	
Bol'sheretskiy Sovkhoz	288	" (50)	3-4	
Mutnovskiy Volcano	300	noted (100)	4-5	
Petropavlovsk-Kamchatskiy	350	" (100)	4	Fright in type B buildings (50)
Yelizovo	360	awoken (5)	3-4	
Avacha	380	noted (+)	4-5	Type B buildings
Karymskiy volcano	452	noted (100)	3-4	
Zhupanovo	500	" (100)	4	
Afrika C.	780	" (100)	4	
Krutoberegovo	800	weak (100)	4	
Matua I.	330		4	
Simushir I.	490		3	
North Urup I.	620		2-3	
Beringa I.	840		2-3	

The axes of the main compression stresses at the focus of the main jolt ran perpendicular to the island arc, and of the tension and interstitial stresses --along it.

A type of mechanism of the focus and orientation of the axes of the main stresses analogous to the main jolt were characteristic of the jolts that occurred in the northern part of the hypocentral area of the aftershocks (Fig. 4). At the focal points of the aftershocks in the southern part of the hypocentral area a focal mechanism was observed similar to the mechanism of the main earthquake, but the direction of the axes of compression and tension stresses in them had shifted in the reverse direction.

The group of focal points forming the central part of the aftershock area is characterized by nearly latitudinal orientation of the main compression stresses, and the directions of the axes of tension and interstitial stresses intersect the strike of the main structures at slight angles.

The tensor of the stresses in effect within the focal zone (Fig. 3 (II)) was determined using a method worked out by O. I. Gushchenko and I. G.

Simbieva [5] and V. M. Zobin. It is noteworthy that the systems of the main stresses in effect at the focal points of the main jolt and the aftershocks with a magnitude of $M \geqslant 5$ are fully contained within a single tensor.

Table 4. Parameters of the Severo-Kuril'sk Earthquake According to Instrument and Macroseismic Data

	Параметры изосейст (1)					
	r_{max}	r_{min}	r_{ep}	D^*	K^*	DK^*
(2) $I_{он}$ – балльность в эпицентре по $I_{он} = bM_{и} - S\lg h_{и} + c$	7,6	7,6	7,6	7,6	7,6	7,6
(3) $I_{ом}$ – балльность в эпицентре по таблице из [6]	7,1	7,5	7,2	8,2	8,2	8,2
$h_{и}$ – инструментальная глубина (4)	70	70	70	70	70	70
(5) h_1 – по формуле $I_{он} - I_i = S\lg\sqrt{1 + \Delta_i^2/h_1^2}$	87	30	42	100	58	76
(6) h_2 – то же, только вместо $I_{он}$ берется $I_{ом}$	115	32	67	69	39	52
(3) h_3 – по формуле $I_{он} = bM_m - S\lg h_3 + c$	88	30	55	95	51	63
(6) h_4 – то же, но берутся M_{Mi} и $I_{ом}$	114	27	58	65	38	51
(8) h_5 – то же, но для $I_{он}$ и M_{mi}	88	26	48	88	51	63
(8) h_6 – то же для $M_{и}$ и $I_{ом}$	90	74	86	51	51	51
(9) $M_{и}$ – магнитуда инструментальная	7,6	7,6	7,6	7,6	7,6	7,6
(10) M_m – магнитуда по $I_{ом} = bM_m - S\lg h_2 + c$	7,9	6,5	7,3	8,0	7,2	7,6
(11) M_{mi} – магнитуда из $M_{mi} = 1/b\ (I_i + S\lg\Delta_i - c)$, $i \geqslant 3$	7,9	6,3	7,1	7,9	7,2	7,6

* Parameters of the theoretical isoseismal lines: D--long semiaxis, K--short, $DK = \sqrt{D \cdot K}$.

Key:

1. Parameters of isoseismal lines
2. Intensity at epicenter for
3. Intensity at epicenter according to the table from [6]
4. Instrument depth
5. According to the formula
6. Same, only instead of $I_{он}$, $I_{ом}$ is taken
7. Same, but M_{Mi} and I_{om} are taken
8. Same, but for $I_{он}$ and M_{mi}
9. Magnitude, by instrument
10. Magnitude from
11. Magnitude of

The value of the tensor makes it possible for us to select the actual fault planes that were in action at the focal points of the main jolt and aftershocks; in this case, for the main jolt, the fault plane coincides with the strike north-northwest.

An analysis of the nature of the stressed state at the focal points of the foreshocks of the main jolt and the aftershocks on 28 February showed that the hypocentral area being studied was affected by compression stresses close to horizontal. These stresses determined the primarily strike-slip thrust fault nature of the dislocation at the focal points of the strong earthquakes in the region of the Northern Kuril Islands which occurred in 1973.

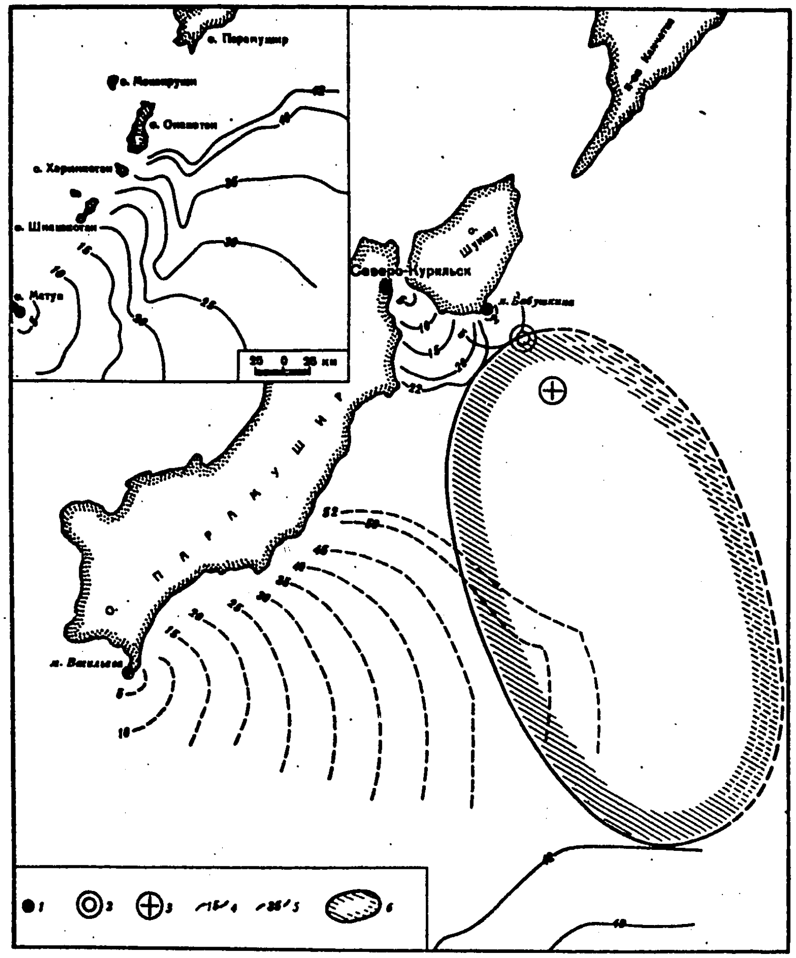

Figure 6. Map of the Reach of the Tsunami Waves on 28 February

1--locations of tide gage unit; 2--epicenter of earthquake according to data from Japan; 3--epicenter of earthquake according to data of Sakhalin Complex Scientific Research Center (USSR). The isochrones of the range of the tsunami: 4--from locations where there were instrument observations; 5--from locations from which data were obtained only by visual observations; 6--focus of tsunami

Table 5. Data From Observations of Tsunami on 28 February 1973

(1) Пункт	(2) Первая волна				
	(3) Время прихода, день, час, мин	Подъем (+), спад (−) (4)	Амплитуда, см (5)	(6) Период, мин	Время пробега, час, мин (7)
(12) Северо-Курильск	28 07 00	+	76	40	00 22
(13) о-в Шумшу	28 06 45	−	3–4	31	00 07
(14) о-в Матуа	28 07 20	+	7	10	00 42
(15) м. Васильева	28 07 36	+	40	11	00 52

(8) *Окончание*

(1) Пункт	(9) Максимальная волна				(10) Продолжительность колебаний, час	Примечание (11)
	Время прихода, день, час, мин (3)	Подъем (+), спад (−) (4)	Амплитуда, см (5)	Период, мин (6)		
(12) Северо-Курильск	28 07 00	+	76	40	30	Мареограф (16)
(13) о-в Шумшу	28 06 56	+	60	32	30	"
(14) о-в Матуа	28 ?	?	?	?	3	"
(15) м. Васильева	28 10 43	+	80	7	0,5	Визуально (17)

Key:

1. Location
2. First wave
3. Arrival time, day, hour, mins
4. Rise (+), recession (-)
5. Amplitude, cm
6. Period, min.
7. Transit time, hour, mins
8. Conclusion
9. Maximum wave
10. Duration of vibrations, in hrs
11. Comments
12. Severo-Kuril'sk
13. Shumshu Island
14. Matua Island
15. Vasil'yeva Cape
16. Tide gage
17. Visually

The information obtained makes it possible, with certain assumptions, to outline the presumed focus of the tsunami (Fig. 6). In this case the western side of the outline of the focus, on the basis of the available data, was plotted quite reliably (it is shown on the diagram by the solid line), and the eastern one is plotted in accordance with symmetry with the western one, on the basis of the assumption of the correct form of the focus in the abyssal zone. This assumption is related to the lack of information necessary to plot the wave picture from the east.

If one takes into consideration the fact that the outline of the focus of the tsunami is plotted, the energy of this tsunami may be estimated.

We will approximate the shape of the focus by an ellipse with the axes 2a=104 km and 2b=58 km. Then its area is $S=4.74\cdot10^3$ km^2. The height of the wave, h_0, at the epicenter, determined from the maximum height of rise of the water on the coast (h = 60 cm) at a location close to the epicenter (Babushkina Cape, where the tide gage of the Shumshu station was established) corresponds to 13.1 [7]. By knowing the initial height of the tsunami, h_0, the area of the focus, S, the density of the water ρ and the acceleration of the force of gravity, the amount of energy of the tsunami may be estimated from the formula $E_u = S\rho g h_0^2$. The amount of energy for this earthquake appeared to be equal to $8.8\cdot10^{18}$ erg.

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JUNE EARTHQUAKES AND TSUNAMI IN THE REGION OF THE KURIL ISLAND CHAIN IN 1973

L. S. Oskorbin, L. N. Poplavskaya, M. I. Rudik, N. A. Shchetnikov, A. N. Boychuk, N. N. Leonov, M. D. Ferchev, T. N. Khantayeva

In 1973 the islands of the Lesser Kuril chain were twice hit by 8-point temblors, caused by the earthquakes on 17 June at 03:55 with M=7.9, and on 24 June at 02:43 with M=7.6 (Greenwich time). The third strong earthquake, which followed on 26 June at 22:31 with M=7.6, was also apparently accompanied by a considerable macroseismic effect, but for objective reasons this effect could not be separated from the effect of the first two jolts.

A study of the macroseismic effect, the manifestations of the tsunami, the seismic conditions and the focal mechanism of the three main and several dozen extremely strong repeat and preliminary jolts was made by a large group of associates from the Sakhalin Complex Scientific Research Institute of the Far East Science Center of the USSR Academy of Sciences. The gathering, processing and summarizing of the macroseismic material were performed by L. S. Oskorbin, N. N. Leonov and M. D. Ferchev. The information on the manifestations of the tsunami was gathered and summarized by N. A. Shchetnikov. M. I. Rudik determined the dynamic parameters of the focal points. The instrument data were summarized by L. N. Poplavskaya, A. N. Boychuk and T. N. Khantaeyva.

Instrument Data

The spatial coordinates of the focuses on 17, 24 and 26 June and their aftershocks with M=4.5 were determined on a Minsk-22 computer according to the EPITsENTR program [1], which applied one of the most generally used methods of determining the coordinates of epicenters of Kuril-Okhotsk earthquakes--the median method [2-4]. The depths of occurrence of the hypocenters in the overwhelming majority of cases could be calculated from the differences in pP-P or sP-P [5-6]. Moreover, information on the pP-wave was taken from observations of the teleseismological stations [7, 8], and the arrival times of the sP waves were taken directly from the seismograms of nearby stations. The magnitude of the main jolts of the parameters was determined from the oscillation amplitudes in the surface wave on the recordings of the Far East stations. The basic data on the earthquakes on 17, 24 and 26 June and their repeat jolts are given in the article, "Earthquakes in the Kuril Islands and the Sea of Okhotsk" in this collection. Given here is a map of the epicenters of the earthquakes with M=6.5-8 during the period of observations from 17 June to 31 December 1973 (Fig. 1), as well as basic information on the three main jolts (Table 1).

Table 1. Basic Data on the June Earthquakes With $M \geq 7$

(1) Число	(2) Момент возникновения, час, мин, сек	φ°N	λ°E	H, км	M_{LH}
17	03 55 04	43,1±0,1	145,9±0,1	50±5	7,9
24	02 43 26	43,1±0,1	146,5±0,1	50±5	7,6
26	22 32 00	42,9±0,1	146,9±0,1	50±5	6,9

Key:
1. Date
2. Moment of occurrence, hrs, mins, secs.

A detailed study of the area of the earthquakes on 17-26 June and their repeat jolts, made in [9], made it possible to establish the following:

1. The main jolts on 17, 24 and 26 June took place outside the area encompassed in 1969 by the Shikotanskiy earthquake on 11 August [11].

2. The hypocentral areas of the aftershocks of the earthquakes on 17, 24 and 26 June ran transverse to the strike of the Lesser Kuril arc, with the focal zones of the first two main jolts not mutually intersecting, and the area of the aftershocks of the earthquake on 26 June ran at almost a right angle to the epicentral areas of the earthquakes on 17 and 24 June.

3. In the process of development of the focal areas of 17-26 June a single hypocentral zone was formed, oriented similarly to the aggregate of main jolts and strongest aftershocks (see Fig. 1).

Seismic Conditions of the Focal Zone of the June Earthquakes

This work sets forth the following results of the study of the series of aftershocks of the earthquakes from 17-26 June according to the data for 1973.

1. The frequency graph of the aftershocks, described by the function

$$\lg N = a + bM, \quad (1)$$

where N is the number of jolts of a given magnitude M, and M varied from 4.5 to 6 with a spacing of ΔM=0.25; a and b are the parameters.

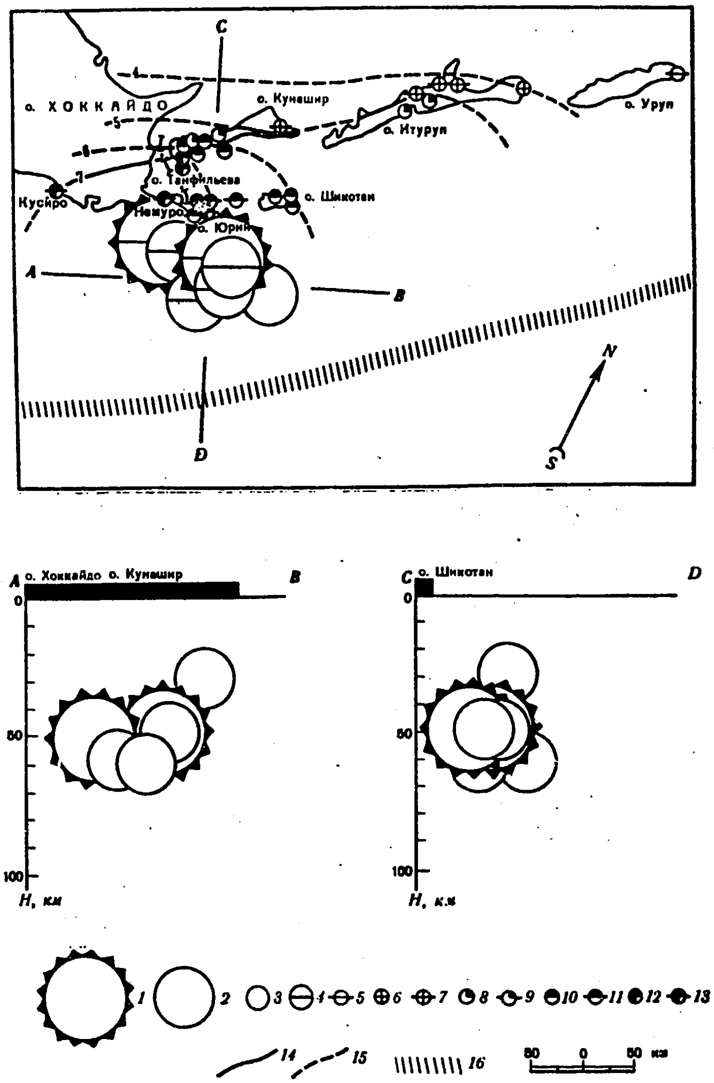

Figure 1. Map-Diagram of Earthquakes in the Region of the Lesser Kuril Chain and Projection of Their Hypocenters onto Vertical Planes, Parallel (AB) and Orthogonal (CD) to the Strike of the Island Chain

[Key on following page]

Key to Figure 1:

Classification by magnitude M: 1--$M \geqslant 7.5$; 2--$7.5 > M \leq 6.5$. Classification by depth of focus H, km: 3--$0 \leqslant H \leqslant 30$; 4--$30 < H \leqslant 60$. Macroseismic effect (points): 5--3-4; 6--4; 7--4-5; 8--5; 9--5-6; 10--6; 11--6-7; 12--7; 13--7-8; 14--isoseismal line of given point (certain); 15--same (uncertain); 16--axis of deep-sea trough

Table 2. Change in Parameters of the Seismic Conditions in the Region of the Lesser Kuril Chain

Период (1) наблюдений	a	b	A	B	N_0	p	Магнитуда сильнейшего афтершока (2)
17–23 июня (3)	5,42	−0,88	37	40	141	−1,2	6,5
24–26 июня	3,05	−1,14	180	330	151	−0,9	6,0
26–30 июня	6,68	−1,14	136	22	25	−0,8	5,5
17–30 декабря (4)	–	–	–	–	398	−1,5	–
17 июня – 31 декабря	7,06	−1,14	–	–	–	–	–

Key:

1. Period of observations
2. Magnitude of strongest aftershock
3. June
4. December

2. The characteristics of the release of elastic deformations in the series of June earthquakes, which was approximated by the straight line

$$\Sigma E^{1/2} = A + B \lg t, \quad (2)$$

where E is the energy of the individual jolt; t--the time, measured in days; A and B--parameters.

3. Distribution of the number of repeat shocks in time, which was described by the function

$$N = N_0 t^p, \quad (3)$$

where N is the number of jolts in a unit of time τ=4 hours, and the time varied from the moment of occurrence of the main jolt on 17 June; N_0 and p are the parameters.

Table 2 shows the values of the parameters of the functions (1)-(3), obtained from the data from observations from 17 June to 31 December 1973.

An investigation of the process of formation of the hypocentral area of the earthquakes from 17-26 June and their repeat jolts and analysis of the characteristics of the seismic conditions (Table 2) of this area permit the following conclusions to be drawn:

1. The earthquakes on 17, 24 and 26 June apparently should be regarded as independent events, each of which was accompanied by a series of repeat shocks.

2. In the course of time a single hypocentral area, directed in conformance with the strike of the island arc, formed in the region of the Lesser Kuril chain.

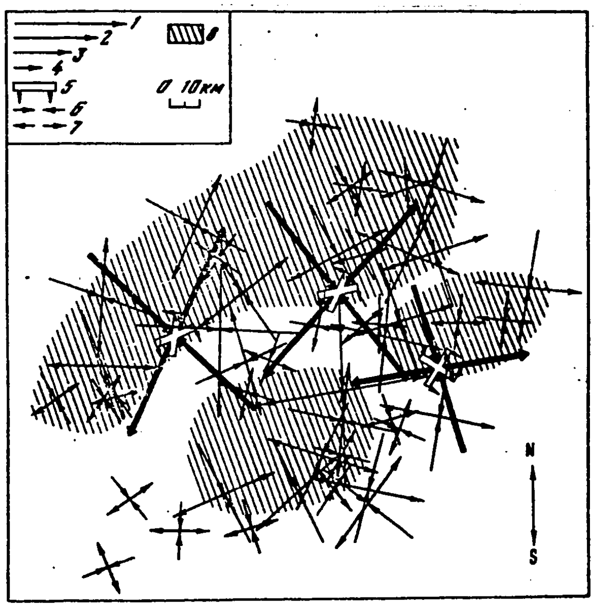

Figure 2. Direction of the Strike of the Fault Planes in the Focal Centers of the Earthquakes on 17, 24 and 26 June and Orientation of the Axes of Compression and Tension Stresses in the Series of Lesser Kuril Earthquakes

Classification by magnitude: 1, 2 correspond to Fig. 1; 3--$6.5 > M \geqslant 5.25$; 4--$M \leqslant 5$; 5--orientation and direction of dip of possible fault planes I and II; 6--orientation of axes of main compression stresses; 7--same for main tension stresses; 8--area of primarily strike-slip thrust fault dislocations

Preliminary Data on the Focal Mechanism of the Earthquakes on 17-26 June

Information on the dynamic parameters of the main shocks on 17, 24 and 26 June, as well as the earthquakes preceding and following, are given in Table 3. By analyzing Figure 2 it is possible to trace the orientation of the possible fault planes in the focal centers of the principal jolts, as well as the axes of the main compression and tension stresses.

Strike-slip thrust fault dislocations, which were determined by the effect of the nearly horizontal compression stresses, were observed in the focal centers of the principal shocks and the overwhelming majority of aftershocks, The focal centers forming an extensive area adjacent to the shelf zone of the islands of the Lesser Kuril chain and Hokkaido Island were primarily subject to strike-slip thrust fault shifts. A similar type of dislocations was also observed in the focal centers of the southeastern part of the hypocentral area of the aftershocks. Strike-slip normal fault dislocations are characteristic of the focal centers of the "oceanic" part of the aftershock area, as well as of the earthquakes, the focal centers of which are located in the narrow strip separating the area of primarily strike-slip thrust fault movements.

The focal mechanisms of the main earthquakes on 17 and 24 June are similar. Two possible nodal planes were found for them, one of which runs along the strike of the Lesser Kuril chain, and the second--orthogonally.

Both possible fault planes at the focus of the main earthquake on 26 June ran at a certain angle to the strike of the structures forming the island arc.

The focal mechanisms of the repeat shocks in most cases are analogous to the mechanisms of the main earthquakes on 17, 24 and 26 June. For some of the aftershocks, as well as the majority of preliminary jolts, a focal mechanism is traced that is similar to the Shikotan earthquake on 11 August 1969 [11].

Macroseismic Effect of the Earthquakes on 17 and 24 June

Information on the perceptibility (see Fig. 1) pertains mainly to the earthquake on 17 June, but in some cases the effect is apparently cumulative with the effect of the earthquake on 24 June.

Information on the damage observed on the islands of the Lesser Kuril chain was processed by N. V. Shebalin's method [10], and is given in Table 4, the data from which were used to calculate certain parameters of the earthquake on 17 June and the intensity at its epicenter. In this case the following values of the coefficients were taken: b=1.5, S=4.5, c=4.5.

The parameters of the earthquake on 17 June, calculated from the macroseismic data, were obtained as follows: the average focal depth was 34 km, maximum--42 km; magnitude 7.5, intensity at the epicenter according to the instrument data 8.9, according to the macroseismic data--8.5.

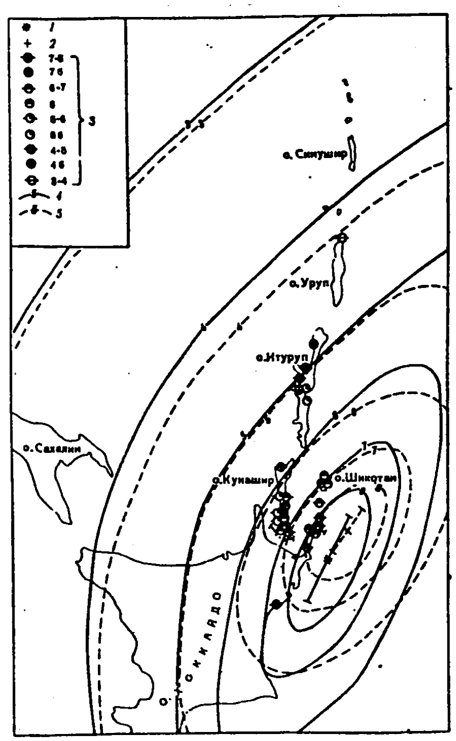

Figure 3. Theoretical Isoseismal Lines of Earthquakes on 17 and 24 June 1973.

1--instrument epicenter of earthquake on 17 June; 2--same, on 24 June; 3--intensity; 4--theoretical isoseismal lines of earthquake on 17 June; 5--Same for earthquake on 24 June

The theoretical isoseismal lines for the earthquakes on 17 and 24 June were calculated according to N. V. Shebalin's method.

Information on the focal mechanism of these earthquakes was used to determine the orientation of the theoretical isoseismal lines. Two plottings were made for each isoseismal line of the two possible fault planes. Then, in accordance with the best conformance of the theoretical isoseismal lines and actual data from observations, preference was given to one of the orientations (Fig. 3).

Results of Determining Focal Mechanisms of Lesser Kuril Earthquakes

Дата (1973 г.)	Время возникновения, час, мин, сек	Координаты очага			Магнитуда M, m_{PV}	Плоскость I			
		$\varphi^{o}N$	$\lambda^{o}E$	H, км		Азимут падения	Угол падения	Компоненты подвижки	
								по простиранию	по падению
1	2	3	4	5	6	7	8	9	10

Key:

1. Date
2. Time of origin, hrs, mins, secs
3. Coordinates of focus: φ °N
4. Coordinates of focus: λ °E
5. Coordinates of focus: H, in km
6. Magnitude, M, m_{PV}
7. Plane I: azimuth of dip
8. Plane I: angle of dip
9. Plane I: components of shift: along strike
10. Plane I: components of shift: along dip

1	2	3	4	5	6	7	8	9	10
					Foreshocks				
5.II	04 30 33	43,6	147,8	55	4,4	278	88	0,906	-0,423
4.IV	21 50 55	43,5	147,6	35	5,1	64	70	0,875	-0,848
4.IV	23 56 44	43,2	148,0	35	4,9	308	68	0,891	-0,454
5.IV	22 17 00	43,4	147,9	35	5,9	67	66	0,875	-0,485
6.IV	00 01 57	44,2	147,2	30	5,2	328	67	0,898	-0,438
6.IV	01 48 00	44,0	147,2	25	5,7	26	64	0,500	+0,866
6.IV	14 58 02	43,4	147,9	30	4,7	17	76	0,732	+0,682
					Main Jolt				
17.VI	03 55 04	43,1	145,9	50	7,9	280	46	0,736	+0,682
					Aftershocks				
17.VI	05 12 08	42,5	146,3	30	5,4	00	66	0,615	+0,788
17.VI	05 52 11	42,9	146,2	40	5,0	328	62	0,829	-0.838
17.VI	08 17 48	42,9	146,6	40	4,7	264	70	0,777	-0,629
17.VI	08 48 20	43,0	146,5	45	5,0	312	66	0,838	-0,545
17.VI	12 14 26	42,8	145,5	45	5,0	168	60	0,559	+0,825
17.VI	12 24 36	42,4	146,7	40	5,6	236	64	0,719	+0,695
17.VI	13 33 28	42,9	145,5	35–40	5,3	137	72	0,695	+0,719
17.VI	13 43 07	42,8	146,9	45	5,5	319	70	0,848	-0,529
17.VI	14 24 14	42,5	145,6	50	4,6	275	80	0,848	-0,529
17.VI	18 55 40	42,7	146,7	40	5,5	142	70	0,857	+0,515
17.VI	19 03 33	42,5	146,6	20	5,5	163	72	0,934	-0,358
17.VI	20 38 00	42,5	146,1	60	6,4	140	80	0,927	-0,375
18.VI	02 19 33	42,8	146,1	30	5,0	316	60	0,755	+0,656
18.VI	05 37 36	42,5	146,6	45	5,4	260	68	0,891	-0,454
18.VI	17 45 43	42,3	146,1	25	6,0	21	73	0,945	+0,325
18.VI	18 24 20	42,3	145,5	30	5,0	194	58	0,669	-0,743
18.VI	20 31 35	42,5	146,5	20	4,8	00	75	0.719	+0,695

Плоскость II				Напряжение					
Азимут падения	Угол падения	Компоненты подвижки		сжатия		промежуточное		растяжения	
		по простиранию	по падению	A_z°	e°	A_z°	e°	A_z°	e°
1	2	3	4	5	6	7	8	9	10

Key:

1. Plane II: azimuth of dip
2. Plane II: angle of dip
3. Plane II: components of shift: along strike
4. Plane II: components of shift: along dip
5. Stress: compression: A°_z
6. Stress: compression: e°
7. Stress: interstitial: A°_z
8. Stress: interstitial: e°
9. Stress: tension: A°_z
10. Stress: tension: e°

1	2	3	4	5	6	7	8	9	10
				Foreshocks					
8	74	0,998	−0,052	138	19	357	74	235	16
322	64	0,921	−0,391	195	35	05	56	104	04
50	64	0,906	−0,423	177	34	02	54	270	02
324	64	0,898	−0,438	195	35	13	53	105	01
69	66	0,913	−0,406	198	34	118	54	289	01
272	53	0,809	+0,557	47	11	323	40	160	60
275	52	0,962	+0,275	49	17	303	49	153	38
				Main Jolt					
158	60	0,615	+0,788	132	09	228	32	26	57
				Aftershocks					
118	46	0,809	+0,587	334	11	71	34	230	54
76	60	0,838	−0,545	202	43	21	48	292	02
11	52	0,898	−0,438	131	42	331	45	230	10
56	60	0,891	+0,454	181	39	18	50	276	05
295	46	0,707	+0,707	145	08	240	31	39	58
351	52	0,819	+0,574	206	06	302	40	108	48
27	46	0,906	+0,422	167	16	73	39	274	44
62	60	0,914	−0,406	189	36	19	52	283	06
12	58	0,978	−0,207	140	29	350	54	238	14
244	62	0,939	+0,342	104	05	203	54	09	34
336	70	0,951	−0,309	195	27	13	62	104	02
46	70	0,985	−0,174	274	22	72	66	182	08
71	54	0,777	+0,629	287	05	16	39	191	54
01	60	0,914	−0,406	128	33	318	52	220	03
110	68	0,951	+0,309	340	01	76	62	250	26
315	52	0,731	−0,682	70	54	257	35	165	03
256	44	0,933	+0.358	34	18	283	41	138	40

1	2	3	4	5	6	7	8	9	10
19.VI	02 22 06	43,0	146,7	40	5,2	316	72	0,798	−0,601
19.VI	02 54 11	42,7	146,1	50	5,7	190	56	0,615	−0,788
19.VI	06 26 13	42,4	145,8	50	4,9	54	70	0,875	−0,485
19.VI	06 37 53	42,7	146,7	40	5,0	294	70	0,898	−0,438
19.VI	08 36 18	43,0	146,4	20	5,1	232	70	0,838	−0,545
19.VI	17 10 11	42,4	146,1	20	5,0	115	80	0,970	−0,242
19.VI	20 05 51	42,6	146,5	30	4,8	78	60	0,629	+0,777
20.VI	09 20 37	43,2	146,0	40	5,0	83	70	0,866	+0,500
22.VI	06 07 37	42,9	146,5	60	6,5	212	70	0,766	+0,643
23.VI	02 09 41	43,1	147,3	50	5,5	231	74	0,906	+0,423
				Main Jolt					
24.VI	02 43 26	43,1	146,5	50	7,6	167	56	0,587	+0,809
				Aftershocks					
24.VI	03 28 36	43,2	146,8	20	6,0	249	80	0,921	+0,391
24.VI	05 07 45	43,0	146,7	30	6,0	128	60	0,732	+0,682
24.VI	10 53 55	43,1	146,5	50	5,0	182	70	0,788	+0,615
26.VI	11 39 24	43,0	146,8	30	5,0	67	64	0,669	+0,743
				Main Jolt					
26.VI	22 32 00	42,9	146,9	50	6,9	125	80	0,743	+0,669
				Aftershocks					
27.VI	01 02 59	42,7	146,7	40	5,0	94	70	0,829	+0,559
27.VI	01 41 16	43,0	146,6	50	5,0	290	70	0,914	−0,406
27.VI	03 15 20	43,0	147,0	50	5,0	222	70	0,788	+0,615
27.VI	03 42 42	42,8	145,7	40	5,0	48	66	0,866	−0,500
29.VI	03 27 54	43,4	146,0	55	5,5	147	56	0,695	+0,719
2.VII	05 51 30	42,8	145,5	50	4,7	153	50	0,342	+0,939
8.VII	09 59 45	43,2	146,6	45	4,5	313	52	0,406	+0,914
12.VII	07 56 16	42,7	146,8	20	5,0	304	80	0,139	−0,990
15.VII	14 06 51	43,4	146,6	45	5,0	244	60	0,788	+0,615
27.VII	19 20 56	43,7	146,6	70	5,3	46	60	0,788	−0,615
3.VIII	06 26 27	42,6	145,9	40	5,0	96	60	0,766	+0,642
4.VIII	06 07 08	42,8	145,6	50	4,5	316	60	0,829	+0,559
9.VIII	10 44 25	43,2	146,6	50	5,7	150	80	0,069	−0,997
10.VIII	15 44 53	43,6	146,4	45	4,5	66	66	0,719	+0,695
25.VIII	15 15 43	43,4	146,8	45	4,2	205	70	0,731	+0,682
24.IX	13 41 21	43,4	146,8	40	4,3	168	54	0,587	+0,809
2.X	08 29 37	43,1	145,5	50	5,4		70	0,743	+0,669
7.X	09 27 02	42,5	146,5	15	5,2	25	60	0,601	+0,798
31.X	23 07 01	42,8	145,3	25	4,4	304	52	0,682	+0,731
5.XI	20 00 40	42,7	146,7	50	4,5	240	68	0,874	−0,484
1.XII	10 38 53	42,9	146,3	40	5,3	302	50	0,559	+0,829
4.XII	01 26 03	43,0	147,2	30	4,5	226	66	0,838	+0,544

1	2	3	4	5	6	7	8	9	10
60	56	0,927	−0,375	185	38	23	51	283	04
318	48	0,642	−0,766	67	60	256	30	165	04
312	64	0,927	−0,375	184	33	356	55	92	04
35	66	0,927	−0,375	163	33	347	58	256	04
335	60	0,914	−0,406	100	36	294	53	195	06
208	79	0,985	−0,174	341	17	158	74	72	02
316	48	0,743	+0,669	104	07	10	32	205	55
340	62	0,914	+0,406	121	04	24	53	216	36
321	52	0,883	+0,469	179	09	280	46	80	42
329	66	0,914	+0,406	191	05	293	60	97	28
				Main Jolt					
294	48	0,707	+0,707	144	05	236	30	40	58
				Aftershocks					
343	66	0,985	+0,714	208	10	318	64	113	22
11	54	0,788	+0,615	159	04	64	38	254	50
287	54	0,914	+0,406	147	10	250	48	49	40
311	48	0,798	+0,601	97	09	359	36	198	52
				Main Jolt					
28	50	0,982	+0,191	160	20	46	48	265	36
				Aftershocks					
352	58	0,914	+0,406	132	07	31	51	227	38
27	66	0,920	−0,391	157	31	341	59	250	02
327	52	0,906	+0,422	187	09	289	46	88	41
308	62	0,906	−0,422	180	38	350	52	88	03
268	54	0,719	+0,695	117	02	209	36	25	54
302	44	0,375	+0,927	139	02	229	15	40	74
168	43	0,438	+0,898	329	06	237	20	75	70
168	14	0,695	−0,719	113	53	215	11	310	36
131	58	0,798	+0,601	276	02	186	43	08	46
294	58	0,819	−0,574	168	46	348	43	78	02
343	56	0,788	+0,615	130	02	37	40	220	49
65	60	0,819	+0,573	101	00	10	45	190	45
358	12	0,438	−0,898	153	36	324	54	59	05
315	50	0,848	+0,529	97	10	00	40	197	48
313	48	0,898	+0,438	173	12	275	44	72	44
297	48	0,629	+0,777	144	02	235	29	48	61
247	50	0,891	+0,454	106	11	208	44	04	46
263	46	0,719	+0,695	53	08	317	30	156	58
179	54	0,643	+0,766	151	02	242	32	58	58
342	62	0,914	−0,406	110	35	295	54	202	04
165	50	0,529	+0,848	143	01	234	25	53	64
331	60	0,898	+0,438	190	04	282	50	96	38

Table 4. Macroseismic Data on the Earthquake on 17 June 1973

Location	Epicentral distance, km	Bldg type	Degree of damage on MSK-64 scale d_1	d_2	d_3	d	Sensation*	I_M, pts	I_B, pts	Comments
Islands:										
Anuchina	40	B		50		2		6-7	6.8	
Yuriy	50	B	100	50		2.3		7-8	7	
Tanfil'yeva	52	B			75	3		7-8	7.1	underground rumble, tsunami up to 1.5 m
Zelenyy	70	B		50	5	3		7-8	7.1	underground ruble from east, tsunami 0.5 m
Polonskogo	80	B	100	20		2		6-7	6.8	tsunami up to 1.5 m
Shikotan Islands:										
Krabozavodsk	118						Fright(100)	6		underground noise
Kray Sveta Cape	132						" (100)	6		
Malokuril'skoye	133	B		5			" (100)	6		
Kunashir Islands:										
Kosa	75	B		100	75			7-8		
Golovnino	80	B			20	2.4		6-7	7	underground rumble, tsunami up to 1 m
Petrovo	90	C		50	10		Fright, awaking(100)	6-7		
Tret'yakovo	95						Noted (100)	5-6		
Sernovodsk	97						awaking (100)	6		underground rumble
Goryachiy Plyazh	100	B,C						6		
Mendeleyevo	105						Same (100)	6		
Yuzhno-Kuril'sk	108	C	100		5		Fright (10), awaking(100)	6-7 6		" "
Lagunnoye	110						Noted (100)	5-6		
Urvitovo	152						" (100)	5		

Location	Epicentral distance, km	Bldg type	Degree of damage on MSK-64 scale d_1	d_2	d_3	d	Sensation*	I_M, pts	I_B, pts	Comments
Iturup Islands:										
Burevestnik	265	C	5					5		
Pionery	280							4-5		underground rumble
Goryachiye Klyuchi	285						awaking(100)	5		
Kuril'sk	302						noted (75)	4-5		
Reydovo	315						" (50)	4-5		
Aktivnoye	360							4		
Urup Islands:										
Kastrikum C.	510							3-4		" "

* The number of cases in % are indicated in parentheses

Table 5. Instrument Data on Tsunami

(1) Пункт	(2) Первая волна					(8) Максимальная волна				
	(3) Время вступления час, мин	(4) Время добегания час, мин	(5) Подъем (+)	(6) Амплитуда, см	(7) Период, мин	(3) Время вступления час, мин	(9) Подъем (+), спад (−)	(6) Амплитуда, см	(7) Период, мин	(10) Пик-пик, см
				17 June 03:55						
(11) Малокурильское	04 22	00 27	+	32	23	07 42	−	86	20	140
(12) Южно-Курильск	05 00	01 05	+	05	23	08 02	−	21	25	25
(13) Буревестник	04 49	00 54	+	25	21	06 42	+	37	20	68
(14) Курильск	05 33	01 38	+	05	12	06 15	−	18	23	33
(15) Северо-Курильск		poor-quality data				08 45	+	10	20	?
				24 June 02:43						
(11) Малокурильское	04 01	00 18	+	09	23	07 28	−	30	20	56
(12) Южно-Курильск	03 49	01 06	+	03	26	04 15	+	06	21	08
(13) Буревестник	03 30	00 47	+	16	28	03 30	+	16	28	23
(14) Курильск	04 05	01 22	+	05	22	05 13	+	07	20	08
(15) Северо-Курильск		poor-quality data				11 04	+	05	46	?
				17 June 03:55						
• (16) Абасири	05 29	01 34	+	?	?	?	?	?	?	?
(17) Ханасаки	04 19	00 24	+	110	16	?	?	152	?	?
(18) Хироо	04 39	00 44	+	110	15	04 39	+	110	15	148
(19) Кусиро	04 26	00 31	+	48	20	05 50	+	55	?	94
(20) Уракава	04 48	00 53	+	?	?	07 55	−	52	15	96
(21) Ямасетомари	05 00	01 05	+	09	12	09 05	−	17	17	37
(22) Саме	05 03	01 08	+	12	?	07 45	−	20	34	33
(23) Мияко	04 48	00 53	+	34	12	07 25	+	36	18	65
(24) Тёси	05 27	01 32	+	?	?	?	?		?	?
(25) Эносима	05 01		No data				No data			
				24 June 02:45						
(16) Абасири	04 26	?	?	?	?	?	?	?	?	?
(17) Ханасаки	03 00**	00 17	+	53	12	04 52	+	66	14	118
(18) Хироо	03 32	00 49	+	28	12	03 32	+	28	12	46
(19) Кусиро	03 21	00 38	+	10	23	04 48	+	18	21	24
(20) Уракава	03 39	00 56	+	06	14	07 17	+	16	17	30
(21) Ямасетомари	03 54	01 11	+	04	17	05 48	+	06	14	10
(22) Саме	03 57	01 17	+	?	?	04 35	+	06	35	09
(23) Мияко	03 41	00 58	+	06	18	03 53	−	09	23	18
(24) Эносима	03 43	01 10	No data				No data			

* Information obtained by measuring recordings on photocopies of tide gages.

** For the Hanasaki location the data obtained from the tide gage differs from those indicated in Fig. 3 in work [14] by 11 minutes (in Fig. 3 the lag time of the first wave is 28 minutes).

[Key on following page]

Key to Table 5:

1. Location
2. First wave
3. Arrival time, hrs, mins
4. Lag time, hrs, mins
5. Rise (+)
6. Amplitude, in cm
7. Period, in mins
8. Maximum wave
9. Rise (+), fall (-)
10. Peak-peak, in cm
11. Malokuril'skoye
12. Yuzhno-Kuril'sk
13. Burevestnik
14. Kuril'sk
15. Severo-Kuril'sk
16. Abasiri
17. Hanasaki
18. Hiru
19. Kusiro
20. Urakava
21. Yamasetomari
22. Same
23. Miyako
24. Tesi
25. Enosima

A comparison of the theoretical isoseismal lines of the two earthquakes confirms the fact that the underground jolts on 17 and 24 June were felt approximately identically on the coastal region of the Kuril Islands and on the islands of Hokkaido and Honshu the earthquake on 24 June was manifested more weakly than the jolt on 17 June. In addition, from an analysis of Figure 3 the conclusion should be drawn that the radii of perceptibility observed were closest to the short axes of the theoretical isoseismal lines.

Manifestation of Tsunami

Two of the strongest jolts in the series of June earthquakes in 1973 caused noticeable tsunami: on 17 June at 03:55 and on 24 June at 02:43 [12]. The tsunami were recorded by the tide gage stations of the Kuril Islands of the Far East coastal region of the Soviet Union and by the tide-measuring (tide gage) stations of the nearby islands of Japan. The parameters of the waves and time of their arrival according to the recordings of the tide-gage stations on the Kuril Islands and the data from Japan [13] are given in Table 5.

An analysis of the table shows that the maximum wave in the tsunami under discussion were observed on the Hanasaki Peninsula (Hokkaido Island, Japan) in the tsunami on 17 June (152 cm). On the Kuril Islands the greatest wave was recorded at Malokuril'skoye Peninsula (Shikotan Island, USSR),also with the tsunami on 17 June (86 cm). The greatest differences in vibrations from the lowest to the highest level in the waves at various stations are given in the "Peak-peak" column.

A comparatively small spread in the periods of the waves was observed in both cases in the tsunami under discussion. With the exception of the recording of the tide gage installed at Same (Japan), where the period was 34 minutes, and at Severo-Kuril'sk, where it is taken uncertainly, due to the poor quality of the recording, the periods of the waves recorded by the instruments of all the other locations are within a range of 12-25 minutes for 17 June and 12-28 minutes for 24 June.

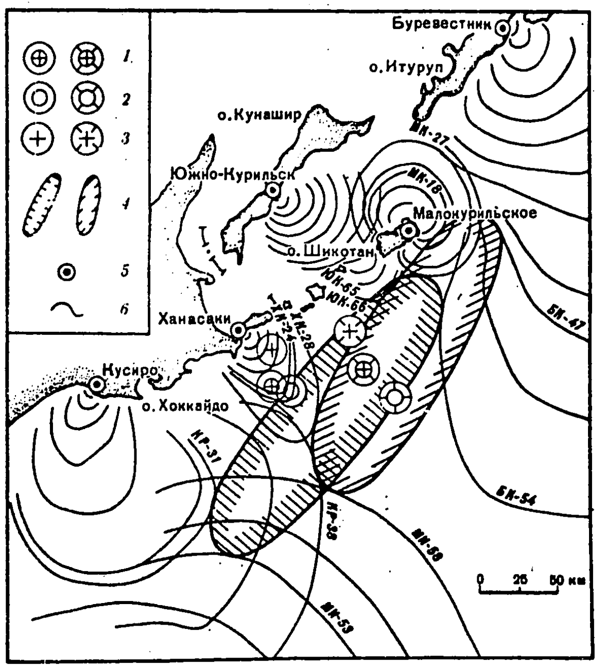

Figure 4. Map of the Wave Run of the Shikotan Tsunami on 17 and 24 June 1973

1--epicenters of the earthquakes according to data from the Sakhalin Complex Scientific Research Institute (USSR); 2--same according to the data of the YaMA (Japan); 3--same according to the data of the NOAA (United States); 4--plotted focal centers of tsunami during 17 and 24 June respectively; 5--locations of tide gage units; 6--isochrones of run of tsunami. Abbreviated designations: BK--Burevestnik, KhK--Hanasaki, KR--Kusiro, MI--Miyako, MK--Malokuril'skoye, YuK--Yuzhno-Kuril'sk.

On all the tide gages the recordings of the first arrivals show a tidal wave, which may attest to a strike-slip thrust fault movement at the focus of the earthquake.

The tsunami caused by the earthquake on 17 June is somewhat stronger than the tsunami on 24 June. This also corresponds to the magnitudes of the earthquakes, since in the first case the magnitude was a half-unit greater than in the second. In both cases, however, it should be related to the quite weak ones, particularly for the Far East coastal region of the Soviet Union. (According to visual data in Japan, on the coastal area of the province of Nemuro, the tsunami on 17 June reached 2 meters and caused some damage: a considerable number of fishing boats were damaged or carried off into the sea [13].

Using the lag time for the waves to reach the coast, the reverse wave patterns were plotted for both cases of tsunami, in order to obtain the outlines of their focal centers (Fig. 4).*

In both cases the focal centers of the tsunami are quite certainly approximated by ellipses which are bounded by the isochrones from the northwest, north and northeast, plotted from the locations of Yuzhno-Kuril'sk, Malokuril'skoye and Burevestnik, and on the south, southwest and west from the Japanese stations of Miyako, Kusiro and Hanasaki respectively. There are, unfortunately, no data from the east due to the lack of tide gages for the open sea. The boundary of the assumed focal centers of the tsunami from the east was plotted by analogy with the western one under the condition of approximating the focal centers by ellipses.**

Assuming that the outlines of the focal centers plotted actually exist, we will estimate the amount of energy of these tsunami.

The measurements of the axes of the ellipses for the focal center on 17 June are 2a=209 km and 2b-58 km, and for the focal centers of 24 June--2a=190 km and 2b=61 km. Then S_1 and S_2 (for 17 and 24 June) will be equal to S_1= =9561 km^2 and S_2=9161 km^2. The heights of the waves, h_{01} and h_{02} at the focal centers of the tsunami, determined according to the maximum amplitudes of the first waves [14, 15], recorded by the tide gage at the Burevestnik post, are estimated as h_{01}=42 cm and h_{02}=18 cm.

By using the values obtained for h_{01}, h_{02}, S_1 and S_2, as well as the values of ρ (density of the water) and g (acceleration of the force of gravity), we can estimate the energy of the tsunami from the formula $E_u = S\rho g h_0^2$. In this case $E_{u1} = 1.65\cdot 10^{20}$ erg and $E_{u2} = 2.8\cdot 10^{19}$ erg.

* In the diagram the isochrones were plotted every 5 minutes, with the exception of the boundary ones, the time of which corresponds to the duration of the run of the waves from specific points to the focal centers of the tsunami. The boundary isochrones are marked by double indexes of the name of the point (abbreviated) of location of the tide gage, from which the reading of the time was made and the figure corresponding to the duration of the run of the first wave. For example, MI-58 designates the boundary isochrone from the Miyako point (Kyusyu, Japan) and the lag time from it, equal to 58 minutes.

** This assumption is completely possible, since it will be located, obviously, within the margin of error in plotting the isochrones when using the existing bathymetry of the region.

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EARTHQUAKES IN THE ARCTIC

A. P. Lazareva

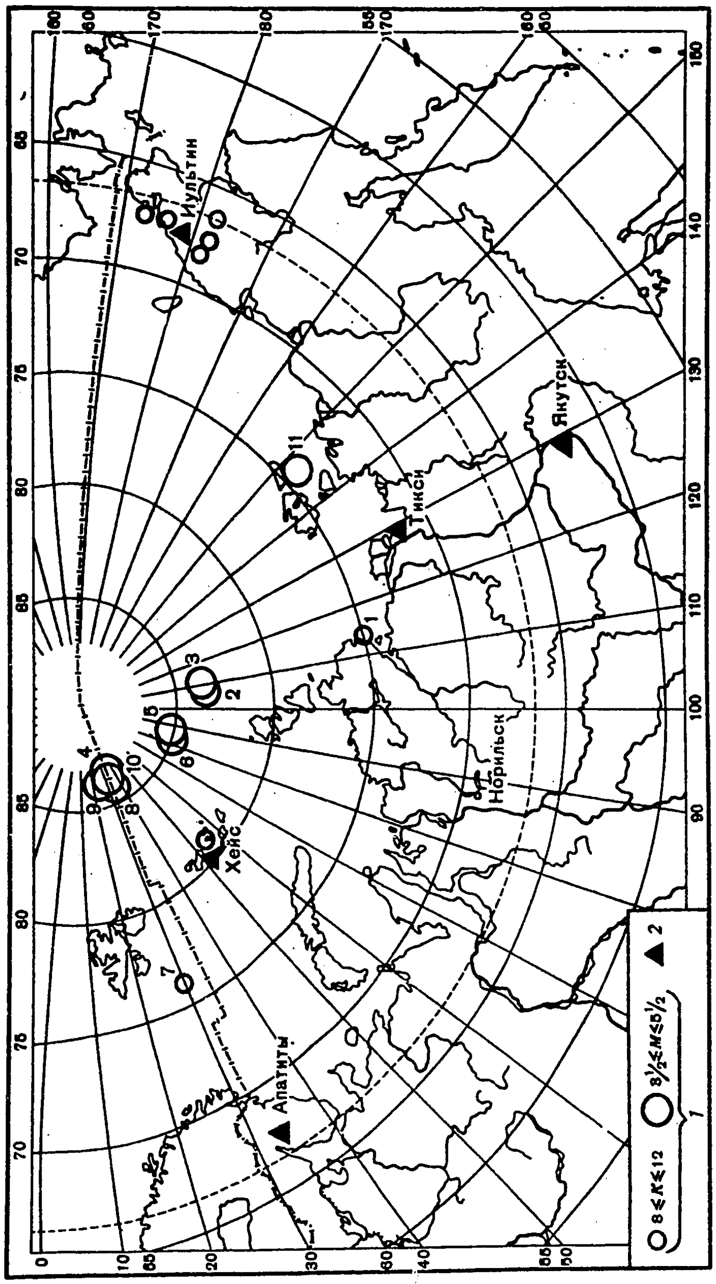
Seismic observations in the Soviet Arctic zone in 1973 were made by the previous network of stations [1]. The parameters, amplitude-frequency and phase responses of the equipment in operation at the stations were published in work [2].

As the result of the large dimensions of the territory of the zone and the small number of stations, only the stronger earthquakes are registered by several stations. The parameters of these earthquakes are given in the catalog from the data of the Operations Seismological Bulletin [3]. The parameters of the weak earthquakes that were not included in this bulletin and were also absent in other summaries of earthquakes [4] were determined by the cross bearing method, if these earthquakes were registered by more than two stations. Several weak earthquakes, inserted in the catalog, were recorded by only one station, and consequently, all their parameters were obtained from the data of this station alone. These instances are mentioned in the notes to the catalog. The energy class (K) was determined from Rautian's nomograph [5]. All the earthquakes are included among surface, non-class ones.

Just as in 1972, the greatest activity was noted in the region of the O. Schmidt Range (φ = 85-86° N, 31° E $\leq \lambda \leq$ 101°E), where six earthquakes occurred with a magnitude of $4.2 \leq M \leq 5.5$ (see diagram). The revival of seismic activity in this region began in 1971.

On 15 December at 23:00 an earthquake with $M \sim 4.7$ was registered, south of Novaya Sibir' Island (Novosibirsk Island archipelago), where not a single focus had been recorded before. On 1 June at 23:29 an earthquake was registered 160 kilometers from the city of Noril'sk, where until this time there had also not been a single epicenter noted. The coordinates of the epicenter and the energy class of this earthquake were impossible to determine, since it was recorded only by a SVKM-3 channel.

It was also impossible to determine the parameters of certain weak earthquakes close to the Kheys seismological station, for example on 15 October at 15:57.



Map of the Epicenters of Earthquakes in the Arctic

1--magnitude of earthquakes; 2--seismological stations

Table 1. Distribution of Close Earthquakes Recorded Only by the Tiksi (T) and Iul'tin (L) Stations

(2) Месяц	(1) Гипоцентральное расстояние (Δ меньше или равно)													
	100		200		300		400		500		600		Всего (3)	
	Т	И	Т	И	Т	И	Т	И	Т	И	Т	И	Т	И
I	2	2	1	3	–	1	–	–	–	2	–	–	3	8
II	1	1	–	5	–	1	–	–	–	–	–	–	1	7
III	3	–	–	2	1	1	2	4	–	1	–	1	6	9
IV	4	–	1	3	–	2	–	5	–	–	–	–	5	10
V	6	–	–	1	1	6	1	3	–	–	–	–	8	10
VI	2	–	1	3	–	2	–	1	–	2	–	–	3	8
VII	1	–	6	4	–	6	–	–	–	–	–	–	7	10
VIII	2	–	1	1	2	1	–	–	–	–	–	–	5	2
IX	2	–	–	2	–	2	–	–	–	–	–	–	2	4
X	5	–	3	1	2	1	–	–	2	1	1	–	13	3
XI	8	2	1	6	1	3	–	–	–	1	–	3	10	15
XII	9	–	2	9	2	2	–	1	–	1	1	1	14	14
(3) Всего	45	5	16	40	9	28	3	14	2	8	2	5	77	100

Key:

1. Hypocentral Distance (Δ less or equal)
2. Month
3. Total

Table 2. Distribution of Earthquakes by Energy

(1) Месяц	$K<8$	$8\leqslant K\leqslant 10$	$10<K\leqslant 12$	Всего (2)
I	5	2	–	7
II	6	2	–	8
III	4	6	–	10
IV	7	3	–	10
V	6	2	2	10
VI	6	1	1	8
VII	8	2	–	10
VIII	–	1	–	1
IX	1	2	–	3
X	–	1	–	1
XI	6	3	–	9
XII	1	2	1	4
(2) Всего	50	27	4	81

Key:

1. Month
2. Total

Information on weak, nearby earthquakes, recorded by only the Iul'tin or Tiksi station, is given in Table 1. The energy class of the nearby earthquakes registered at Tiksi is not determined, since only the vertical SKM-3 channel is in operation.

The distribution of earthquakes by energy, registered by the seismological station at Iul'tin, is given in Table 2.

When the Catalog of Earthquakes in the Arctic Zone was compiled, the original seismograms of the stations at Kheys, Noril'sk and Tiksi and the bulletin of the stations at Iul'tin, Seymchan and Apatity were used.

All the focal points of earthquakes with M$\geqslant$3.5 were located in the Arctic water area, far from population centers, and therefore they were not felt anywhere and there is no macroseismic information.

Catalog of Earthquakes in the Arctic With K$\geqslant$8 in 1973

№ п/п	Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	*M*	*K*	Район	Примечание
			φ^o	λ^o					
1	2	3	4	5	6	7	8	9	10

Key:

1. Number, in order
2. Date
3. Moment of origin, hrs, mins, secs.
4. Coordinates of epicenter: φ°
5. Coordinates of epicenter: λ°
6. Focal depth, in km
7. M
8. K
9. Region
10. Comments

January

	20	15 44 28,5	68,5N	179E			8	Near coast Chukotskiy Sea	From Iul'tin Station data
1	23	21 39 36	75	114E			12	Laptevykh Sea	Origin time from data of Tiksi, Noril'sk stations; coordinates --method of cross bearings from data of Tiksi, Noril'sk, Iul'tin; K--from data of Kheys station.

1	2	3	4	5	6	7	8	9	10
						February			
	6	10 30 04,9	67,3	175,5W			9,5	Near coast Chukotskoye Sea	Data from Iul'tin station
						March			
	23	08 24 47,5	67,7	178,5E			9	Chukotskiy Peninsula	Same
						June			
2	14	12 49 10	83,7	113,1E		3,5		Northeast of Severnaya Zemlya	Origin time, focal coordinates given from Operations Seis. Bull.; M--from data of Noril'sk and Kheys stations
3		19 49 33	83,8	113,5E		4,0		Northeast of Severnaya Zemlya	Acc. to Oper. Seis. Bull.
	28	01 20 24,5	66,5	177,75E			8	Chukotsk Peninsula	Acc. to data from Iul'tin station
						July			
	24	02 20 59,0	67,5	172,5W			9	Chukotskoye Sea	Same
						September			
4	24	09 08 39	86,2	33,2E	30	4,7		O. Schmidt Range	Acc. Oper. Seis. Bull.
						October			
	12	21 41 05,8	81,1	55,5E			10	Zemlya Frants-Iosif	Acc. to data from Kheys station
5	14	22 07 46	85,0	99,7E	30	5,2		O. Schmidt Range	Acc. to Oper. Seis. Bull.
6	18	11 40 22	85,1	98,6E	30	5,5		"	Origin time and epicenter coordinates--from Oper. Seis. Bull; M--from Noril'sk sta. data
						November			
7	05	11 58 18	76,0	30,0E			12	Southeast of Spitsbergen	Origin time from data of Kheys, Apatity st.; epicenter coordinates --cross bearing method from data of Kheys, Apatity, Noril'sk sta; K--from data of Kheis station.

1	2	3	4	5	6	7	8	9	10
8	9	13 42 43	86,0	34,4E		5,5		O. Schmidt Range	From Oper. Seis. Bull.
9		14 47 36	86,1	31,6E	20	4,9		"	Same
10		15 09 33	86,1	30,9E		5,0		"	"
					December				
11	15	23 31 44	74,3	147,2E		4,7		Novosibirsk Islands, south of Novaya Sibir'	"

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WORLDWIDE STRONG EARTHQUAKES

A. M. Kondratenko

It is expedient to examine earthquakes in the USSR, as the manifestation of the overall seismic process in the underground regions of the world, in relation to worldwide strong earthquakes. Among the latter are, as is known, [1], seismic events with magnitudes of body and surface waves no lower than ($M \geqslant 6 \pm 0.25$).

Worldwide strong earthquakes are registered by many seismological stations in the world, which eliminates the possibility of an accidental omission in recording strong seismic events on our planet.

The catalogs of worldwide strong earthquakes published yearly in this collection, describes the earth's seismicity reliably. They may, as data is accumulated over a long period of time, become the representative factual basis of such global seismic studies as the revealing of a unified system of elastic stresses [2], the study of waves of tectonic deformation [3] and the search for conformances to principle in the migration of world seismic activity in time and space [4].

A survey of worldwide strong earthquakes in 1973 was made from the materials of the Unified System of Seismic Observations of the USSR (for the territory of the USSR), the International Seismological Center (ISC) [5] and the National Earthquake Information Center (NEIS) [6]. The results of determin- the basic parameters of the focal points of strong earthquakes are given in the catalog, where earthquakes with $M \geqslant 7 \pm 0.25$ are numbered in chronological order.

In contrast to the past years, the Catalog of Worldwide Strong Earthquakes in 1973 is supplemented with information on the magnitudes of the body waves, determined from the data of the short-period (SKM) and broad-band (SK) equipment of the Unified System of Seismic Observation.

The geographical distribution of the epicenters of worldwide strong earthquakes is shown in Fig. 1. It corresponds to known world statistics of the earthquakes observed in the world [7]. The greatest density of epicenters, as usual, is observed in the Pacific Ocean Seismic belt.

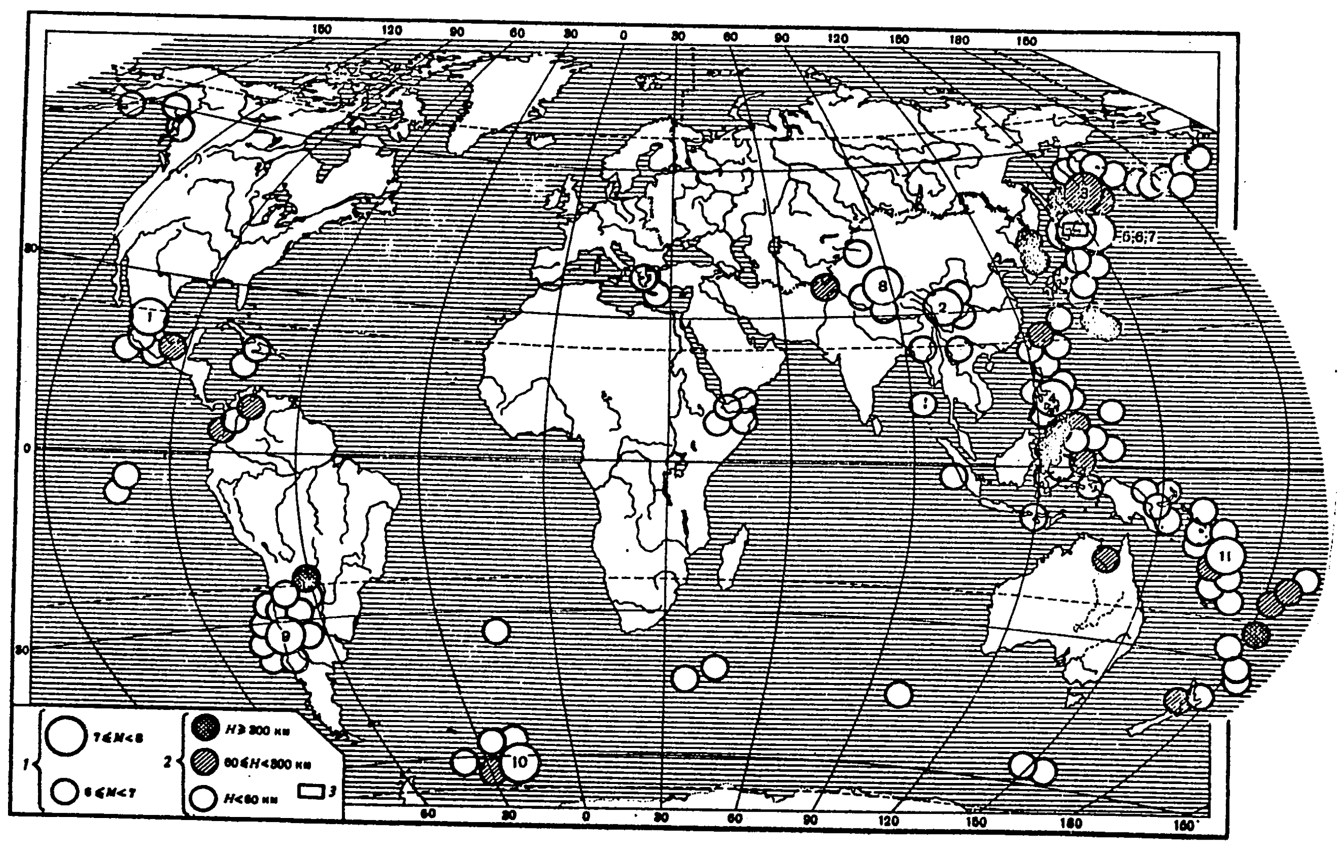

Figure 1. Map of Epicenters of Worldwide Earthquakes With M$\geqslant$6

1--magnitudes; 2--focal depths; 3--area of repeated shocks of Kunashir earthquake

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Table 1. Yearly Frequency of Occurrence of Earthquakes of Recorded Magnitude

(1) Год	(2) Число землетрясений			Всего (3)
	5,75 ≤ M ≤ 6,75	6,75 ≤ M ≤ 7,75	M > 7,75	
1963	87	16	1	104
1964	103	19	1	123
1965	87	46	1	134
1966	74	11	2	87
1967	79	13	–	92
1968	125	26	1	152
1969	100	23	2	125
1970	105	30	–	135
1971	99	19	3	121
1972	108	20	2	130
(4) Среднее за 10 лет	96,8 ± 22,5	19,3 ± 11,3	1,3 ± 0,7	117,8 ± 22,0
1973	142	9	2	153

Key:
1. Year
2. Number of earthquakes
3. Total
4. Average for 10 years

Table 2. Spatial Distribution of Total Seismic Energy

Сейсмический пояс (1)	(2) Число землетрясений		$E \cdot 10^{22}$, эрг	% энергии Земли (3)
	5,75 ≤ M < 6,75	6,75 ≤ M < 8		
(4) Тихоокеанский	116	8	112,39	87,8
(5) Трансазиатский	11	2	14,28	11,18
(6) Антарктический	8	1	0,93	0,72
(7) Атлантический	3	–	0,18	0,18
(8) Прочие	4	–	0,12	0,12

Key:
1. Seismic belt
2. Number of earthquakes
3. % energy of earth
4. Pacific Ocean
5. Transasiatic
6. Antarctic
7. Atlantic
8. Others

The distribution of the number of strong earthquakes in the world according to the value of their magnitude is given in Table 1, where the 1973 data are compared with the corresponding average values for the 10 years preceding.

It can be seen from Table 1 that in 1973 the frequency of earthquakes with varying magnitude does not go beyond the limits of the standard deviations of the average yearly frequency of strong earthquakes in the preceding years.

17 OCTOBER 1979 (FOUO) IN IN 4 OF 4

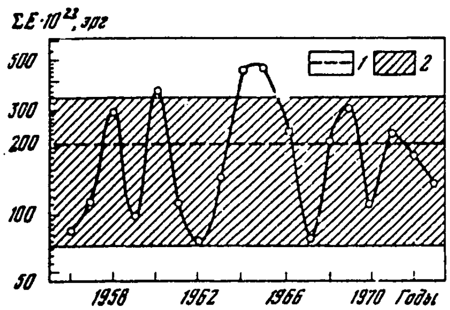

Figure 2. Variations in the Total Seismic Energy ΣE in Time

1--average value of E; 2--area of root-mean-square deviation in relative average value of ΣE

The magnitude estimates of the strong earthquakes made it possible, from the conversion formulas [8], to estimate the seismic energy released from their focal points. The conversion formulas are as follows:

$$E = 10^{11,8 + 1,5 M} = 10^{5,8 + 2,5 m} \quad J$$

Table 2 shows how the total seismic energy released from the focal points of strong earthquakes in 1973, is distributed throughout the world territory.

The total seismic energy is 51.4 percent of the corresponding average in the preceding 10 years. An evaluation of the fluctuations in the change in time of the average yearly seismic energy from 1956 to 1973 (Fig. 2) revealed their random nature, since the discrepancy in individual yearly values relative to the mean is close to unity.

The strongest seismic events in 1973 are constituted by two earthquakes: on 30 January with M=7.8 in Mexico and on 17 June with M=7.9 in the Kuril Island region.

The Mexican earthquake occurred near Lake Chapala. According to the report of the American Center for Short-Term Phenomena, the earthquake was felt and also inflicted damage in a large territory of the states of Colima, Jalisco and Michoacan over a total area of 125 square kilometers. Tsunami about 1 meter high were observed in the coastal region. The earthquake was accompanied by aftershocks for 13 days. The strongest aftershock with M=6.1 occurred on 10 February, 200 kilometers southwest of the main jolt.

A separate article in this collection is devoted to the earthquake on 17 June.

Catalog of Worldwide Earthquakes With M $\geqslant$ 6 in 1973

№ п/п ($M \geqslant 7$)	Число	Момент возникновения, час, мин, сек	Координаты эпицентра		Глубина очага, км	M_{LH}	m_{PV}		Район
			φ°	λ°			СКМ	СК	
1	2	3	4	5	6	7	8	9	10

Key:

1. Number, in order (M $\geqslant$ 7)
2. Date
3. Moment of origin, hrs, mins, secs
4. Coordinates of epicenter: φ°
5. Coordinates of epicenter: λ°
6. Focal depth, in km
7. M_{LH}
8. m_{PV}: SKM
9. m_{PV}: SK
10. Region

January

	1	11 42 36,1	35,56S	15,59W	24	5,9	5,8		South Atlantic chain
	5	13 54 29,2	39,02S	175,23E	145		6,0	6,6	New Zealand
	15	09 02 59,1	27,06N	140,22E	487		6,0	6,1	Nampo Island
	18	09 28 13,7	6,88S	150,03E	38	6,6	6,4	7,2	South of New Britain Island
	22	00 37 59,3	18,54N	105,11W	38	6,4	5,8		West of Mexico
		23 45 35,8	5,98S	149,70E	61	5,8	5,5	6,4	New Britain Islands
	23	04 49 45	12,10S	166,52E	90	6,1	6,2	6,6	South of Santa Cruz I.
	28	17 43 13,5	19,82S	169,02E	58	5,8	6,2	6,4	New Hebrides Islands
1	30	21 01 13,8	18,53N	102,93W	48	7,8	6,7	6,9	Mexico
	31	20 55 54	28,22N	139,3E	508		6,3	6,7	Nampo Islands

February

	1	07 27 42	17,72S	175,07W	207		5,8	6,2	North of Tonga Islands
2	6	10 37 07	31,33N	100,49E	55	7,5	6,9	7,4	China
	7	16 06 25,8	31,50N	100,33E	35	5,9	6,0	6,3	China
	8	10 09 09,6	45,58S	96,31E	40	6,1	5,9	6,3	Australian-Antarctic Uplands
	10	11 53 29	18,78N	103,79W	42	6,1	5,8	6,1	West of Mexico
	14	16 11 14,4	30,54S	177,39W	29	6,2	6,1	6,3	Kermadek Islands
	19	08 42 52,7	45,49S	35,17E	33	6,0	5,2		Africa-Antarctic chain
	25	05 35 57,1	61,1S	38,01W	41	6,2			West of S. Sandwich Islands
		10 31 42	1,75S	99,65E	58	5,9	5,8	6,3	Indonesia
3	28	06 37 54,4	50,51N	156,58E	62	7,4	6,4	7,0	Kuril Islands

1	2	3	4	5	6	7	8	9	10
					March				
	4	17 57 46	54,8N	161,70E	58	6,2	6,1	6,2	Kamchatka
	9	10 06 34	6,32N	127,38E	70–80	6,3	6,5	6,9	Southeast of Mindanao I.
	12	11 14 23,5	50,02N	156,8E	52	5,7	5,8	6,2	Kuril Islands
		12 39 02	4,20N	126,50E	31	5,7	5,7	5,8	Indonesia
		19 39 21	50,8N	157,2E	71	6,3	6,1	6,5	South of Kamchatka Pen.
	16	00 51 46,5	2,18N	126,65E	11	6,4	6,3	6,5	Indonesia
4	17	08 30 53	13,41N	122,87E	44	7,4	6,4	6,7	Philippines
	18	11 06 14,8	2,09N	126,55E	33	6,5	6,3	6,7	Indonesia
	23	06 55 32,5	51,27N	174,16E	21	6,0	6,1	6,5	Aleutian Islands
		19 42 40,9	29,30N	130,41E	51	6,0	6,0	6,2	Ryukyu Islands
	24	00 34 38,8	31,74N	139,37E	27	5,9	5,5	6,0	South of Honshu I.
	26	02 37 20,4	23,45N	123,92E	7	6,2	5,8	6,2	Ryukyu Islands
	28	13 42 11	11,77N	42,89E	70	5,8	5,7	6,0	Eastern part of Equatorial Africa
		14 18 55	11,69N	42,93E	52	5,8	5,5	5,6	Same
		14 59 07	11,76N	42,78E	39	5,8	5,7	6,1	"
		23 55 44	23,40N	123,83E	6	6,0	5,5	5,9	East of Taiwan I.
					April				
	1	07 12 41	11,63N	43,00E	65	6,0	5,7	6,2	Eastern part of Equatorial Africa
	3	13 54 01	4,70N	75,67W	146		6,4		Colombia
	5	22 16 58	43,54N	147,77E	19	6,0	5,9		Kuril Islands
	7	03 00 59,6	7,00N	91,32E	39	6,6	6,2	6,5	West of Nikobarsky Islands
		12 22 49,3	58,5S	13,6W	36	6,2			Southwest Atlantic Ocean
	8	12 41 02,8	15,81S	167,24E	38	6,3	6,0	6,6	New Hebrides Islands
	12	13 49 15	50,7N	157,6E	70	6,3	6,2	6,4	South of Kamchatka Pen.
	17	12 34 27,3	4,32S	134,26E	28	6,5	6,2	6,5	New Guinea Islands
		14 21 56,3	5,81N	127,15E	54	5,7	6,5	5,6	Southeast of Mindanao I.
		22 09 51	50,8N	157,6E	60	5,7	5,7	5,8	South of Kamchatka Pen.
	24	21 30 06,2	4,96N	78,12W	20	6,4	6,5	7,1	Western Colombia
	25	21 34 33	59,38S	26,12W	19	6,0		6,8	South of Southern Sandwich Islands
	26	20 26 27	20,05N	155,16W	9	6,0	5,8	6,4	Hawaiian Islands
					May				
	4	11 27 13,3	2,3N	126,7W	33	5,7	6,2	6,5	Indonesia
	12	16 20 09,2	3,7S	152,1E	13	5,9	6,1	6,6	New Ireland Islands
	26	12 19 34,4	51,4N	179,7W	39	6,0	5,8	6,3	Aleutian Islands
	29	01 46 44,9	51,7N	176,2E	46	5,9	5,8	6,3	" "
		06 14 22,3	54,0N	163,8W	30	5,7	6,4	6,4	
	31	23 39 56,7	24,3N	93,5E	30		6,1	6,3	India
					June				
	2	23 57 04,2	44,1N	83,6E	26	5,9	5,8	6,3	China
	5	03 12 25,8	17,2S	167,8E	24	6,1	6,0	6,4	New Hebrides Islands
	9	08 21 27,3	10,3S	161,4E	70	6,3	6,5	6,8	Solomon Islands
	11	08 42 04	53,5N	161,7E	45	6,5	5,9	6,4	East of Kamchatka Pen.

1	2	3	4	5	6	7	8	9	10
	12	14 21 23	53,6N	161,6E	10-20	5,8	5,5	6,2	East of Kamchatka Pen.
	15	11 20 46	53,4N	161,4E	54	6,2	6,1	6,4	Same
		21 09 38	53,5N	161,6E	10	5,7	5,6	6,0	"
5	17	03 55 02	43,2N	145,8E	50	7,9	6,9	7,4	Kuril Islands
		13 33 28,3	43,0N	145,4E	46	5,7	5,7	6,4	East of Hokkaido I.
		13 43 08,7	43,0N	146,7E	40	5,8	5,9	6,2	Same
		18 55 39,6	43,0N	146,5E	45	5,8	5,9	6,4	Kuril Islands
		19 03 35,1	42,7N	146,3E	32	5,7	5,6		East of Hokkaido I.
		20 37 57,3	42,7N	146,0E	50	6,5	6,1	6,4	Same
	18	17 45 43,7	42,5N	146,0E	29	6,0	5,9	6,4	"
	19	03 34 19,4	8,1N	137,3E	33	6,1	5,9	6,5	Caroline Islands
	22	06 07 37,9	42,9N	146,3E	53	6,4	5,9	6,3	Kuril Islands
6	24	02 43 25	43,4N	146,5E	57	7,2	6,8	7,5	" "
		03 04 16	43,1N	146,9E	42		6,2		" "
		05 07 47	43,2N	146,7E	53	5,9	5,7	6,2	" "
	26	18 02 25	43,2N	141,1E	50	6,2	5,8	6,2	" "
7		22 31 59	43,2N	146,7E	50	6,9	6,4	6,7	" "
	29	03 26 53	43,3N	145,8E	55	5,5	5,8	6,5	" "
					July				
	1	13 33 34,6	57,8N	137,3W	33	6,9	6,6	7,2	Bay of Alaska
	3	06 37 34,4	12,3N	125,4E	44	5,9	5,8	6,2	Philippines
		07 03 43,9	12,2N	125,3E	33	6,6	6,3	6,6	"
		16 59 35,1	58,0N	138,0W	33	6,1	6,5	6,5	Bay of Alaska
	5	22 46 16,3	13,2N	124,7E	38	6,4	6,0	6,3	Phillipines
	6	09 27 30,7	27,2S	71,1W	34	5,7			Chile
	12	15 41 39,3	27,2S	71,5W	15	5,8			"
8	14	04 51 21,0	35,2N	86,5E	33	7,0	6,5	6,6	China
		13 39 30	35,3N	86,6E	33	5,9	6,0	6,5	"
	16	18 12 57,5	17,3N	100,7W	44	5,8	6,1	6,6	Mexico
	20	08 12 53,5	36,4N	141,0E	46	6,0	6,0	6,5	Japan
	21	04 19 17,1	24,8S	179,2W	411		6,3	6,3	Southwest of Tonga Islands
	25	06 08 38,7	8,7S	160,7E	69	5,9	5,5	5,9	Solomon Islands
	28	20 06 35	50,3N	149,0E	597		6,1	6,1	Sea of Okhotsk
	31	05 41 04,0	37,7S	73,4W	32	5,7	5,9		West of Chile
		10 51 13,2	27,1S	71,5W	33	6,4	6,3	6,8	" "
		20 44 52,2	8,8S	161,0E	30	6,0	5,5	6,2	Solomon Islands
					August				
	1	01 31 30,9	14,3S	167,3E	200		6,7	7,1	New Hebrides Islands
		15 44 25,5	26,8S	71,0W	16	5,8			West of Chile
	3	17 23 52	54,6N	162,6E	0	6,0	5,4	6,4	Kamchatka Pen.
	7	14 22 45,4	26,8S	70,9W	14	6,5	6,2	6,7	West of Chile
	9	10 44 26,5	43,4N	146,4E	55	6,0	6,1	6,5	Kuril Islands
		13 06 36,6	56,3S	147,4W	33	5,8			Australia-Antarctica uplands
	10	00 08 05,8	34,0N	141,4E	55	5,8	5,4	6,0	Southwest of Honshu I.
	11	07 15 39,7	33,0N	104,0E	33	6,3	5,9	6,3	China
	16	03 58 10,7	23,1N	101,1E	33	5,8	5,7	6,0	"

1	2	3	4	5	6	7	8	9	10
		12 16 59,8	51,3N	176,6W	47	6,0	5,9	6,3	Aleutian Islands
	18	08 25 44,1	11,5N	121,4E	14	6,3	6,2	6,8	Philippines
	22	06 39 21,4	32,8S	179,2W	33	6,0	6,4	6,1	South of Kermadek I.
	23	23 50 32,4	37,2N	142,1E	34	5,7	5,7	6,0	East of Honshu I.
	25	03 44 34,2	10,6N	138,4E	33	5,7	6,0	6,1	North of Caroline Islands
	26	01 46 14,1	0,2N	125,0E	85		5,9	6,4	Indonesia
	28	09 50 40,0	18,3N	96,6W	84		6,8	6,9	Mexico
	30	08 54 32,4	37,3S	179,4E	46	5,7			New Zealand
		18 25 43,1	7,3N	72,8W	181		5,8	6,0	Colombia
				September					
	2	00 29 26,2	7,4N	123,7E	61,9		5,5	5,7	Philippines
	5	13 03 13,9	39,5N	143,1E	41	6,4	5,8		East of Honshu I.
	8	07 25 43,9	33,2N	86,7E	33	6,0	5,6	6,1	China
	9	18 25 49,4	39,5N	143,1E	23	6,4	6,0	6,3	East of Honshu I.
	10	07 43 30,5	42,5N	130,9E	532		6,4	6,4	Sea of Japan
	11	23 18 50,8	25,6N	124,5E	141		6,2	6,4	East-China Sea
	18	13 32 51,5	54,5S	132,6W	33	5,8			South Pacific uplands
	20	20 43 39,8	9,0N	123,8E	560		6,2	6,3	Philippines
	21	07 13 34,0	4,4S	102,[illegible]W	33	6,0			East Pacific uplands
		07 31 02,8	4,4S	101,9W	33	5,9			Same
	21	19 28 29,3	26,1S	178,3E	651		5,6	5,3	North of Kermadek I.
	25	16 17 28,3	54,8S	145,8E	33	6,1	5,8	6,1	Australia-Antarctica uplands
	29	00 44 00,8	41,9N	130,9E	575		6,7	6,6	Sea of Japan
	30	06 17 [illegible]2,6	35,6N	140,4E	62		6,1	6,3	Japan
				October					
9	5	05 45 27,3	33,0S	71,9W	14	6,9	6,4	6.9	West of Chile
10	6	15 07 37,3	60,8S	21,5W	33	6,8			Southeast of Southern Sandwich Islands
	9	07 57 31,0	14,2S	167,2E	9	6,3	5,7	6,1	New Hebrides Islands
	17	03 16 18,6	36,4N	71,2E	221		5,5	5,9	Afghanistan
	18	10 49 37,5	19,4N	105,0W	45	6,1			Mexico
	25	06 41 11,3	13,8N	120,2E	63	5,8	6,1	6,3	Philippines
		14 08 59,5	22,0S	63,7W	529		6,2		
				November					
	4	15 52 11,7	38,9N	20,4E	8	5,7	6,9	6,1	Ionian Sea
	6	09 36 05,0	51,6N	175,4W	34	6,5	5,6	6,4	Aleutian Islands
		18 26 35,1	51,6N	175,2W	41	6,4	5,8	6,3	" "
	8	08 59 11	49,9N	156,4E	55	6,3	5,9	6,5	Kuril Islands
	11	02 43 07	49,9N	156,5E	65	6,0	6,1	6,4	" "
	19	13 01 56,1	38,9N	141,9E	56	6,5	6,3	6,8	Honshu I.
	28	08 12 31,4	41,9S	42,8E	33	6,0	6,0	6,2	West-Indian chain
	29	00 29 56,4	3,5S	145,9W	33	5,7	5,6	6,2	Sea of New Guinea
		10 57 42,7	35,2N	23,8E	26	5,8	6,2	6,4	Mediterranean Sea
	30	08 09 55,4	15,2S	167,4E	124		6,4	6,7	New Hebrides Islands

1	2	3	4	5	6	7	8	9	10
				December					
	1	17 00 56,2	35,6S	74,5W	35	5,7	6,2	5,9	West of Chile
		23 18 03,9	43,2N	146,9E	40	6,4	6,1	6,3	Kuril Islands
	8	06 10 03,5	0,2S	98,4E	33	5,7	5,9	6,3	Indonesia
	9	19 55 45,6	19,9S	169,8E	39	6,6	6,4		New Hebrides Islands
	14	17 37 35,4	51,4N	177,9W	53	5,9	6,3	5,5	Aleutian Islands
	19	04 43 01,5	9,4S	119,5E	58	5,9	6,5	6,8	Indonesia
		12 55 57,1	20,6S	176,5W	246		5,9	6,3	West of Tonga Islands
11	28	13 41 45,8	14,5S	166,6E	26	7,3	6,2	6,5	New Hebrides Islands
	29	08 20 12	54,6N	168,6E	15	6,3	5,7	6,0	East of Komandorsky Islands
	30	16 39 29,7	15,5S	166,6E	10	6,6	6,3	6,7	New Hebrides Islands

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SPECTRAL AND TEMPORAL CHARACTERISTICS OF P-WAVES OF STRONG EARTHQUAKES IN 1973 (ACCORDING TO DATA FROM THE FREQUENCY SELECTION SEISMIC STATION AT THE OBNINSK CENTRAL SEISMOLOGICAL OBSERVATORY)

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This article publishes data on the spectral composition of P-waves according to the recordings of the frequency selection seismic station for 12 strong earthquakes with $M \geqslant 5.5$ which occurred in 1973.

The basic parameters of these earthquakes, taken from the Operational Seismological Bulletin of the YeSSN [Unified System of Seismic Observations] and also the magnitudes, m_{PV} of the YeSSN, the m_{PV} of the observatory at Obninsk and the magnitude m^*_{max}, calculated for the maximum value of A/T in the frequency selection seismic station-spectrum of P-waves, are given in Table 1.

The values of the oscillation rate A/T in the corresponding periods are given in Table 2, which also includes the values of A/T*, related to the middle of the frequency band of the filter at the level 0.7, from $(A/T)_{max}$, for the points that are located beyond the passband of the given filter [1]. On the graph T_1-T_2 are given the limiting periods of the active band of the spectrum at the level 0.5 of $(A/T)_{max}$.

For earthquakes Nos 5, 8, 10 and 11 there are no values of T_1, since their spectrums are open from the direction of the short periods.

In the Chinese earthquakes there is not such clear tracing of the expansion of the active band of the ChISS [frequency selection seismic station]-spectrum (Fig. 1, a), with increase in magnitude m^*_{max}, as was observed in the series of Shikotan earthquakes [2]. For example, the active band of the spectrum of earthquake No 1 with m^*_{max}=5.8 is broader (T_1-T_2=1.4--9.0 sec) than the more active band of the spectrum of earthquake No 3 with m^*_{max}=6.7 (T_1-T_2=0.9-3.9 sec). It is possible that this is because of the special characteristics of the focal points of the Chinese earthquakes or earthquake (No 3) is located deeper. Of the five earthquakes of this series, only for earthquake No 5 on 11 August 1973 is the focal depth, H=25 km, determined.

Table 1. Basic Parameters of Earthquakes

(1) № землетрясения	Дата (1973 г.) (2)	Час (3)	Район (4)	Δ°	H, км	$\bar{M}$ ЕССН M_{LH}	$\bar{M}$ ЕССН m_{PV}	$m_{PV}^{обн}$	m^*_{max}	T
1	3.I	14	(5) Северный Памир	28,4	–	5,2	5,6	–	5,8	5,2
2	6.II	10	(6) Китай, Сычуань	50,1	–	7,5	6,9	7,1	7,2	2,2
3	2.VI	23	(7) Китай, Синьцзян	31,7	–	5,7	6,2	6,7	6,7	2,2
4	14.VII	04	(8) Китай, Тибет	39,5	–	7,0	6,6	6,7	6,6	2,2
5	11.VIII	07	(6) Китай, Сычуань	50,9	25	6,3	5,9	6,6	6,5	3,5
6	28.II	06	(9) Курилы, Парамушир	63,4	70	7,5	7,2	7,5	7,6	32
7	12.III	19	Южное п-ова Камчатка (10)	63,4	65	6,3	6,5	6,4	6,3	5,2
8	15.VI	11	Восточнее п-ова Камчатка (11)	62,5	50	6,2	6,4	6,8	6,8	1,2
9	17.VI	03	Курилы, Кунашир (12)	64,3	–	7,9	7,4	7,6	7,7	5,0
10	22.VI	06	То же (13)	64,8	–	6,4	6,4	6,7	6,6	1,2
11	24.VI	02	"	64,4	–	7,6	7,5	7,5	7,5	4,2
12	26.VI	22	"	65,1	–	6,9	6,7	7,2	7,1	1,3

Note. $m_{PV}^{обн}$ - is the magnitude for the P-wave, Obninsk station; m^*_{max} is the maximum magnitude for the spectrum of the P-wave; T is the corresponding period.

Key:

1. Number of earthquake
2. Date
3. Hour
4. Region
5. Northern Pamir
6. China, Sichuan
7. China, Xinjiang
8. China, Tibet
9. Kuril, Paramushir
10. Southern Kamchatka Peninsula
11. Eastern Kamchatka Peninsula
12. Kuril, Kunashir
13. Same

In the spectrum of the earthquake on 6 February (No 2) with a magnitude of m^*_{max}=7.2 (in the period T_M=2.2 sec), a second maximum appears at the period T=34 sec, but the value A/T of the second maximum is less by an order of magnitude than for the first maximum.

The spectrums of the earthquakes in the Kuril-Kamchatka zone are given in Figure 1, b.

The spectrum of the strongest earthquake (No 9) of this group (17 June) in the Kuril Islands with m^*_{max}=7.7 is double-peaked, has an active band of T_1-T_2=1.7-10 sec, and the maximum oscillation rate $(A/T)_{max}$ is confined to the period T_M=5 sec.

The active band of the spectrum is narrowed because of the fact that the long-period maximum in the period T=34 sec has an oscillation rate much less than the basic maximum determining the magnitude m^*_{max}.

Table 2. Spectral Distribution of the Oscillation Rate $(A/T)_{max}$ of the P-waves

(A) № землетрясения	1		2		3		4		5		6		7		8		T_1-T_2
	T	A/T	T	A/T	T	A/T	T	A/T	T	A/T	T	A/T	T	A/T	T	A/T	
1	1,0	0,07	1,6	0,11	3,2 2,4*	0,14 0,12	5,2	0,20	7,0 14*	0,18 0,05							1,4–9,0
2	1,0	0,54	1,4	1,04	2,2	2,20	5,2	1,40	8,0 14*	1,32 0,44	20 24*	0,21 0,18	34 40*	0,21 0,17	5,0 75*	0,18 0,14	1,4–8,5
3	0,9	0,64	1,2	1,16	2,2	1,15	2,8 5,0*	1,14 0,27	8,0 14*	0,15 0,06	14 25*	0,05 0,01					0,9–3,9
4	0,9	0,13	1,2	0,32	2,2	0,72	–	–	12	0,35	21	0,38	31 40*	0,24 0,17	48 75*	0,18 0,14	1,3–22
5	0,9	0,32	1,2	0,42	2,8	0,50	3,5 5,0*	0,44 0,27	8,0 14*	0,24 0,09	12 25*	0,07 0,01					7,0
6	0,9	0,33	1,4	0,57	2,8	0,88	4,4	1,24	12	1,62	32	4,20	40	3,08	50 75*	2,24 1,48	15–56
7	1,0	0,10	1,2	0,15	9,8	0,17	5,2	0,21	10 13*	0,17 0,13	20 25*	0,09 0,07	30 45*	0,07 0,04			1,0–17
8	0,9	0,55	1,2	0,86	2,4	0,55	4,8	0,35	11	0,17	20 25*	0,09 0,07	28 45*	0,05 0,03			3,2
9	0,9	1,36	1,2	2,10	2,8	5,12	5,0	6,04	15	2,06	18 25*	1,17 0,74	34 45*	1,60 1,25	56 75*	1,30 1,26	1,7–10
10	0,9	0,46	1,2	0,49	2,0	0,33	5,6	0,20	12	0,17	20 25*	0,14 0,11	26 45*	0,08 0,04			4,0
11	0,9	1,17	1,4	1,80	2,4 2,5*	2,70 0,36	4,2 5,0*	4,20 0,17	16	1,53	22	1,60	34 45*	2,04 1,60	42 70	1,48 0,64	1,7–3,4
12	0,9	0,40	1,3	0,97	2,0	1,39	4,5	0,64	16	0,48	21	0,61	28 45*	0,33 0,18			1,6–6,5 1,2–4,1

Note. T--period in sec; A/T--in mC/sec; 1, 2, ...--numbers of octave channels; *--additional points; T_1-T_2--active band of spectrum in sec. A--Number of earthquake

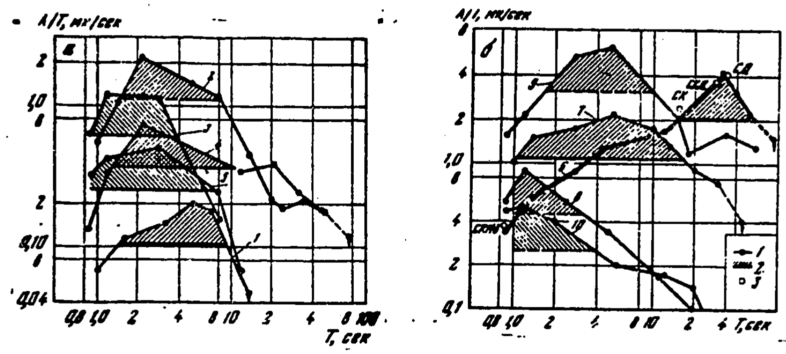

Figure 1. ChISS-Spectrums of P-Waves of Strong Earthquakes

a--Chinese; b--Kuril-Kamchatka zone: 1--spectrums of individual earthquakes (number corresponds to those in table); 2--active band of spectrum at level 0.5 $(A/T)_m$; 3--oscillation rates (A/T) according to basic equipment at Obninsk Central Seismological Observatory

An analysis of the spectrums of the earthquakes in the Kuril-Kamchatka zone shows that the basic conformances to principle in the changes in the spectrums from the magnitude are mainly retained. The spectrums of some of the earthquakes of this group, however, have substantial deviations from them. For example, the spectrums of the earthquakes on 15 June at Kamchatka (No 8) and on 22 June (No 10) in the Kuril Islands are open at the left, and the maximum oscillation rate is confined to the period T_M=1.2 sec.

The earthquake on 28 February at Paramushir Island is particularly interesting. The ChISS-spectrum of this earthquake is depicted in Fig. 1, b under No 6. As can be seen from the diagram, on the short-period slope of the spectrum there is a slow build-up of the oscillation rate. For example, in the period T=0.9 sec, the oscillation rate A/T=0.33 mC/sec, which corresponds to a magnitude of m^*_{max}=6.4. This magnitude was also determined for this earthquake according to the SKM-3 equipment of the seismological stations at Obninsk and Petropavlovsk-Kamchatskiy. In the period T=12 sec the oscillation rate reached values of A/T=1.62 mC/sec, which corresponds to a magnitude m^*_{max}=7.0. A similar magnitude was obtained according to the SK equipment at the Central Seismological Observatory and the YeSSN (average magnitude $^{YeSSN}_{PV}$=7.0).

This is explained by the fact that most of the YeSSN stations are equipped with SK sets and in averaging the magnitudes m_{PV}^{YeSSN} mainly magnitudes were included that were calculated in periods of 10-12 sec. According to the SKD equipment, however, in a period of T=28 sec, $^{Obn}_{PV}$=7.5, and according to the CS-2 equipment (data of the Obninsk seismological station) in the period T=32 sec-- $^{Obn}_{PV}$=7.6, which corresponds to the maximum magnitude m^*_{max} in the period T=32 sec for the ChISS data.

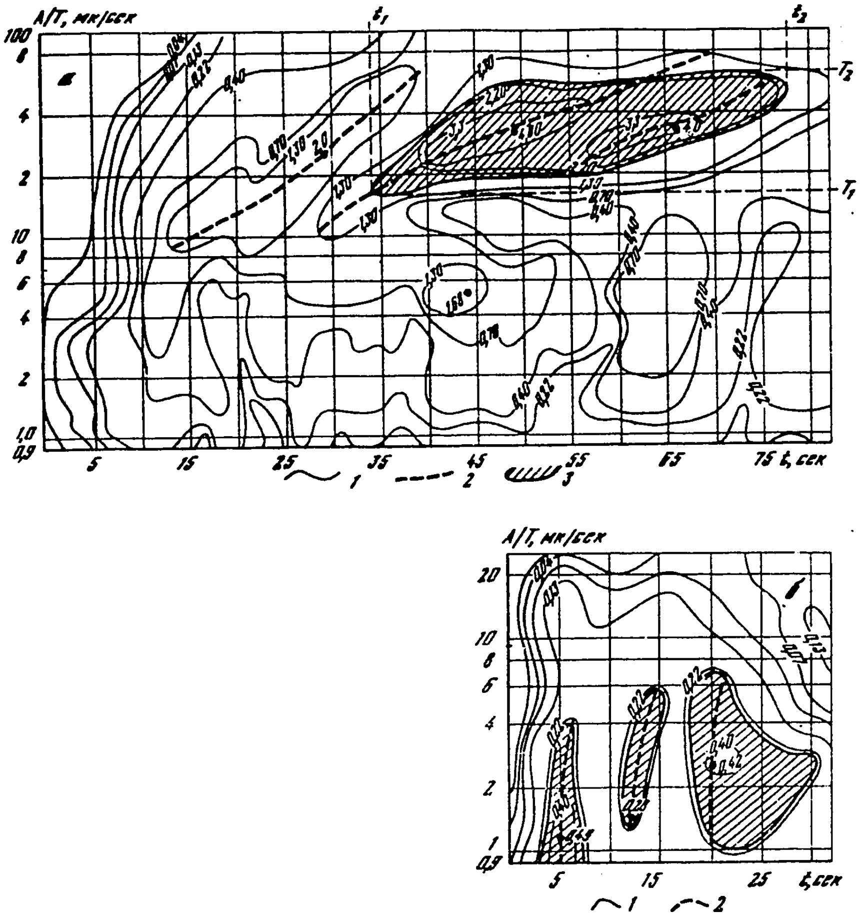

Figure 2. Frequency-Time Fields

a--Paramushir earthquake on 28 February; b--Kunashir earthquake on 22 June 1973; 1--isolines of the topography; 2--peaks of the topography; 3--conditional area S

When averaging the magnitude m_{PV} for the YeSSN stations, the spectral distribution of the magnitudes should be taken into consideration [3]. This is apparently also because of the fact that the magnitudes m_{PV} of the Obninsk station coincide well with the maximum magnitude m^*_{max} for the ChISS and as a rule both of them are higher than the average m^{YeSSN}_{PV} by 0.3-0.4 units of magnitude.

The earthquake on 28 February on Paramushir Island has a number of essential special characteristics. The limiting periods T_1-T_2 of this earthquake are 15-56 sec, and for earthquakes with a magnitude m^*_{max}=7.6--1.4-28 sec [1].

Table 3. Parameters of Frequency-Time Fields

(1) № землетрясения	(2) Дата (1973 г.)	m^*_{max}	τ_M, сек	T_M	K_M	T_1, сек	T_2, сек	t_1, сек	t_2, сек	K	S
6	28.II	7,6	48	32	0,16	15	56	34	78	0,7	17,2
10	22.VI	6,6	5	1,2	1,31	3	8	0	4,0	0,7	2,1

Designated in the table are: m^*_{max}--the spectral-maximal magnitude; τ_M--the duration of the build-up in maximum intensity $(A/T)_{max}$; T_1, T_2-- the limit periods of the active band of the spectrum at the level 0.5 $(A/T)_{max}$; t_1, t_2--the limits of the time interval at the same level; $K_M = m^*_{max}/\tau_M$--the characteristic slope of the build up $(A/T)_{max}$; K--the duty factor; S= $(\lg T_2 - \lg T_1)$; K--the conditional area outlined by the isoseismal lines of the magnitude.

Key:

1. Number of earthquake
2. Date

The formula expressing the conformance to principle of the formation of the righthand (long-period) limit of the spectrum $\lg T_2 = 0.35\ M - 1.2$ [4], is not carried out for the earthquakes in the Kuril-Kamchatka zone (Nos 6, 10).

For the earthquake on 28 February, T_2, calculated from the formula, is much less obtained from spectrum No 6, and for the earthquake on 22 June, T_2, calculated, is obtained more from spectrum No 10 (Fig. 1, b). It is hard to explain the formation of the lefthand slope of the absorption spectrums in this case, since both earthquakes were registered by the Obninsk station alone, and their epicenters are located in a single focal zone (Kuril Islands).

An essential factor affecting the ChISS-spectrum is the depth of the focus of the earthquake. In works [1, 2, 4, 5] it was shown that the spectrums of the deeper earthquakes are narrower, and the maximum of the spectrum has shifted toward short periods. For the earthquake on Paramushir Island (28 February), the maximum oscillation rate is confined to the period T_M=32 sec, and the active band of the spectrum $(T_1 - T_2)$ has substantially shifted toward the long periods.

According to the data from the Operational Seismological Bulletin, the focal depth of this earthquake (H=70 km) is close to intermediate ($80 \leqslant H \leqslant 400$ km) [6], and according to the data [5], the focal depth is 40 km, i.e., in each case the earthquake is subcrustal.

Therefore, both the earthquakes under discussion have their own special features. Frequency-time fields were constructed for the earthquakes (Nos 6 and 10), the parameters of which are given in Table 3. The method of plotting the frequency-time fields is discussed in works [2, 7]. In Figure 2, the time along the seismogram is formed along the axis of the abscissa, (from the beginning of the recording of the earthquake), and the periods T--along the axis of ordinates. The isolines of equal oscillation rates A=A/T const. are plotted on the plane lg(T, t). The intervals between the isolines are taken as equal to 0.25 of the unit of magnitude (5 db).

It can be seen from Figure 2 that the nature of the frequency-time fields of the earthquakes under discussion are different. The frequency-time field of the earthquake on 28 February (No 6) has a number of special features, and differs substantially from the fields described in works [1-5].

As can be seen from Figure 2, a, in the first seconds of the recording of the earthquake at the Obninsk station there is a slow build-up of intensity. In the high-frequency parts of the field there are no energy flash-ups. The value of the oscillation rate increases slowly with respect to time, gradually shifting toward the long periods.

The formula for the length of time for the development of maximum intensiveness $\lg \tau_M = 0.35$ M-1.4 for earthquake No 6 is not carried out. For the earthquakes with a magnitude $m^*_{max}=7.6$ the length of time for development of the maximum intensiveness should be approximately 22 seconds, and for the earthquake under discussion it is the irregularly large $\tau_M=48$ seconds.

The first, comparatively weak energy flash-up, outlined by the isolines A/T=1.3 mC/sec, begins at the 13th second from the beginning of the recording of the earthquake and continues for 26 seconds. The maximal oscillation rate at the center of this flash-up reaches a value of A/T=2 mC/sec, which corresponds to the level of 0.5 $(A/T)_{max}$ of this earthquake.

At the 34th second from the beginning of the recording of the earthquake the main shock begins, which lasted 46 seconds. The section of the second energy flash-up at the level of 0.5 of the maximum, outlined by the isolines A/T=2 mC/sec, indicates that the main part of the energy during the earthquake was released between 34 and 80 seconds in irregularly large periods T=15-56 sec. The conditional area outlined by the isolines $0.5A_M$, is quite large (S=17.2). The characteristic slope of build-up of the maximum (K_M0, as a rule descends with an increase in the magnitude of the earthquake from 2-3 units when M=5 to 0.5 with M=8.5 [4], and for the earthquake described $K_M=0.16$ of a unit. The maximum value $(A/T)_{max}=4.2$ mC/ /sec, determines the magnitude of the earthquake under discussion (m^*_{max}= =7.6 in the period T=32 sec).

The earthquake on 22 June (No 10) on Kunashir Island is weaker in order ($m^*_{max}=6.6$) than the earthquake on 28 February (No 6) on Paramushir Island ($m^*_{max}=7.6$).

The frequency-temporal fields of these earthquakes are different. Three energy flash-ups with maximums every 5, 12, and 20 seconds from the beginning of recording the earthquake are clearly singled out in the frequency-time field of the comparatively weak earthquake No 10. The highest value of the oscillation rate (A/T=0.49 mC/sec), which determines the magnitude (m^*_{max}=6.6) is already reached at the first maximum (τ_M=5 sec).

From the direction of the short periods at a level of 0.5 of the maximum the field is open, and from the direction of the long periods is limited by the period T_2=4 sec. After a negligible reduction in the oscillation rate of the first flash-up (from 11 to 16 seconds from the beginning of the recording of the earthquake), the second flash-up stretches and in shape and position in the frequency-time field is close to the first.

The second flash-up is limited to the periods T_1-T_2=1.4-6.0 seconds.

At the 18th second from the beginning of the earthquake the third energy flash-up starts, which lasts up to 30 seconds and is limited by the periods T_1-T_2=1.0-7.0 seconds. The third flash-up has a conditional area, the largest of the three flash-ups of this earthquake, but its oscillation rate (A/T=0.42 mC/sec) is lower than that of the first flash-up (A/T==0.49 mC/sec).

All this makes it possible to assume that for the earthquake under discussion (No 10) the process of the focal ripping open goes in discrete jolts and is contained in 30 seconds in comparatively short periods (up to 7.0 secs.).

A comparison of the earthquakes (Nos 6 and 10) registered by the Obninsk station from a single focal zone (Kuril Islands) makes it possible to rule out their relation to the epicentral distance and structure of the environment on the propagation path of the seismic waves. The relation of the spectrums and frequency-time fields to the intensities of the earthquakes does not give a full explanation to these divergences. The explanation must be sought in the differing structure and sizes of the focal points of the earthquakes.

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